HONI SOIT QUI MAL Y PENSE
DIEU ET MON DROIT

AGRICULTURAL RESEARCH INSTITUTE

PUSA

THE INTERNATIONAL SUGAR JOURNAL

A Technical and Commercial Periodical
devoted entirely to the Sugar Industry.

316278
IARI

JANUARY TO DECEMBER,

1917.

VOLUME XIX.

LONDON:
ST DUNSTAN'S HILL, E.C 3
1917.

INDEX TO VOLUME XIX.

GENERAL INDEX.

[(*P*) implies *Paragraph.*]

PAGE

Advertisement, An Old-Time Refiners' .. 514
Acarus sacchari, The 245, 253, 514
After-the-War Industries 535
Agricultural Motor, A Cheap 491
Agriculture in the United Kingdom, New Era for 2
Agriculture, Soil Aeration in 3
Aid for West Indian Sugar Factories, Government 51, 247, 343
Alcohol Industry, Prospects of the German (*P*) 279
Alcohol Manufacture in Switzerland from Calcium Carbide 524
Alpha-Naphthol, Quantitative Determination of Minute Accounts of Sugar by.. 26
America, *See also under* United States.
America's Decision in the War 197
American Cane Sugar Industry: An Official Investigation .. 359, 420, 464, 515, 557
American Drawback on Export of Sugar 438, 444
American Opinion on British Sugar Policy 5
American Output of Sugar Factories 202
American Sugar Administration— 437, 446, 454, 486
American Sugar Production, Notes on— 10, 55, 108, 203, 258, 295, 349, 447, 505, 538
American *versus* British Sugar Machinery American Consular Opinion, 6 , Correspondence 88
Anglo-Continental Guano Works Ltd. (*P*) 226
Antigua Central, The new 52
Antiseptic Properties of Sugar in Veterinary Operations (*P*) 158
Argentina, A Sugar Beet Factory in (*P*) .. 426
Argentina. Climatic Conditions . . 4, 279
Argentina Statistics of Sugar Production (*P*) 279
Atkins, E. F. 471

Babinda and South Johnston Centrals, Queensland (*Illustrated*) . . 356
Bacterized Peat, Report on Experiments with 168, 417
Bagasse, Fuel Value of. 28
Bagasse Furnaces (*Illustrated*) . . 496
Balfour of Burleigh Committee on Agriculture 102, 110
Ball Bearings in the Sugar Factory 452
Barbados. Colonial Report 86
Bardorf, C. F. 308
Barometric Condensers.. 16
Bee Candy, Supply of (*P*) 25
Beet Crop in United States, Forecast of (*P*) 413
Beet Cultivation, Influence of, on General Farming 246
Beet Factory in Argentina (*P*) 426
Beet Factory in England Government Aid for .. . . : .. 200, 350
Beet Seed, America's Needs in (*P*).. 179
Beet Sugar Industry in Canada, Efforts to extend (*P*) 278
Beet Sugar Industry, The United States, Federal Commission Report 410
Beet Sugar Production in England— 49, 65, 103, 149, 185, 200, 247, 395
Beet Sugar Production in England: Official Committee Recommendation— 149, 155
Beet, Tare on Sugar 205
Bellingham and Stanley's New Observation Tubes (*Illustrated*).. 76

PAGE

Blake, A. F. 26
Blue, Indanthrene, superseded by Chloranthrene Blue in U.K. (*P*) . .. 111
Blues, Relative Merits of, investigated in Java (*P*).. 374
Boiler Compound, Specification of a Standard (*P*) 75
Boilers in Hawaiian Practice 71
Bone-black compared with Vegetable Decolorizing Carbon 406
Bottomley's Extract of Peat 168, 417
Brazilian Sugar Industry: Figures of Production 248
British Beet Sugar Cultivation— 49, 65, 103, 149, 185, 200, 247, 395
British Cane Mill, A Unique Old 65
British Colonial Reports 86, 568
British Empire League and Trade Marks of Origin (*P*) 279
British Empire Producers' Organization 157
British Guiana, Cane Experiments in 1915 414
British Guiana, Colonial Report 568
British Markets, German Sugar and 389
British Sugar Beet Growers' Society, Ltd — 156, 200
British Sugar Policy and American Opinion 5
British *versus* American Sugar Machinery: American Consular Opinion,, 6 , Correspondence 88
Broussard, Senator, Speech in Congress— 438, 441, 445
Brown Elevating Apparatus (*Illustrated*) .. 73
Brussels Convention, France denounces the 442, 492
Brussels Convention, The: The British Standpoint 533
Burchenal, C D. 79
Business Names Act, Registration of 105
By-Product of Sugar Cane, Wax as a (*P*) . 561
By-Products, Judicious Utilization of in Army (*P*) 570

Calorific Rays, Effect of, on various Paints 229
Canada and West Indies: Proposed Union 152
Canada · Efforts to extend Sugar Beet Industry (*P*) 278
Canada, Quality of Fertilizers in Use in (*P*) 136
Canada, The Sugar Refining Industry in .. 443
Cane Breeding in Porto Rico 364
Cane Cultivation, Effect of Lime in 312
Cane Cultivation in Non-Tropical Parts of India 61
Cane Disease in Porto Rico, Outbreak of New (*P*) 524
Cane Experiments in British Guiana . .. 414
Cane Mill, A Unique Old British (*Illustrated*) 65
Cane Mills, Electrification of 316
Cane Planting in Single and Double Row .. 23
Cane Stripping by Hand before Planting .. 509
Cane Sugar Industry, The American: An Official Investigation 359, 420, 464, 515, 557
Cane Sugar Manufacture, Studies in— 125, 162, 223, 259
Cane Values in Hawaii (*P*) 257
Cane Varieties at Tucumán Experiment Station 562
Carbohydrates, Chemistry of, during 1916. 321
Carbon, Decolorizing, for White Sugar Manufacture 511
Carbon, Vegetable Decolorizing, compared with Animal Charcoal 406
Cards, Sugar, in U K 342, 485
Carr, S. T .. ..
Carriers, Cane, as used in Hawaii 72

Index.

PAGE
Centrifugal, Crystallizer, and Pan Capacity as affected by the Purity of Juice . 351
Centrifugal House, Double Curing System in the (*Illustrated*) .. 299
Centrifugal Pumps in the Sugar Factory 550
Centrifugals in Hawaii .. 72
Chapman, The late Alfred .. 372
Chemical Control as practised in Hawaii, Methods of .. 37
Chemical Industry, Society of: New Sugar Committee .. 201
Chittenden, F. J. .. 417
Chloranthrene Blue as Substitute for Indanthrene (*P*) .. 111
Clarification, Increase in Coefficient of Purity caused by .. 367
Clarified Juice, through Filter-presses, Processes passing . 125, 162, 223
Clerget Method, *see* Double Polarization.
Clyde Sugar Market (*P*) .. 318
Coefficient of Purity caused by Clarification, Increase in .. 367
Commission on the Sugar Supply, Royal— 136, 363, 371, 408, 443, 457, 488
Committee, American Sugar Administration: Members .. 446
Cockroaches: Remedy against (*P*) ... 524
Condensers, Volume of Air in Evaporator .. 23
Condensing Systems, Sugar House— 14, 67, 87, 122, 137, 188, 231
Confectionery, Restrictions in Use of .. 136
Consumption, The Sugar, in United Kingdom .. 50
Contracts, Book of Cane: New Regulations in Cuba (*P*) .. 375
Controller, The Food .. 1, 341
Control of Sugar in the United States 437, 487
Control of the Food Supplies in U K.— 1, 50, 101, 150, 342, 485
Control of the Sugar Consumption in the United Kingdom .. 342, 348
Control, Chemical, in Hawaii .. 37
Control, Simple Formulae for Mill .. 227
Control, Sugar Factory and Refinery: Use of Tintometer . 306
Conveying and Elevating Machinery, The Brown Portable (*Illustrated*) 73
Correspondence— 42, 87, 137, 185, 231, 280, 471, 523, 568
Coxon, Frank— 14, 66, 87, 122, 137, 216, 299, 354, 409, 452, 496, 548
Crop Forecast in India, The 1917-1918 . 482
Crops of the World, Sugar .. 98, 195, 387, 579
Cross, W. E. .. 312, 562
Crystallizer Capacity as affected by the Purity of the Juice 351
Crystallizers as used in Hawaii .. 72
Cuba Cane Sugar Corporation's Experiment Station in Cuba (*P*) 158
Cuba: Central Stewart (*Illustrated*) .. 180
Cuban Affairs 109
Cuban Revolution, The .. 150
Cuban Sugar, Impurities in Raw— 245, 294, 442, 471, 569
Cuban Sugar, Influence of, on the American Sugar Market .. 487, 536
Cuban Sugar Crop: 1915-16 and 1916-17 .. 30
Cuba: Official American Report on Sugar Industry .. 515
Cuba, Prospects in: A Consul's Survey .. 408
Cuba's Soil 152
Curing Systems in the Centrifugal House, Double (*Illustrated*) .. 299
Currency, Decimal .. 345, 482, 570

Danish West Indies, The .. 54, 181
Decimal Currency .. 345, 482, 570
Decolorizing Carbon for White Sugar, Experiments in making .. 511
Decolorizing Vegetable Carbon compared with Animal Charcoal 406
Deerr, Noël .. 232, 298, 351, 401, 503
Defence of Industry, The .. 249, 396, 492, 540
Development Commissioners' Grant to Kelham Scheme (*P*) .. 350

PAGE
Devonport, Lord .. 1, 136, 341
Diatraea saccharalis .. 4
Dicalcium Phosphate, Analyses of 162
Dicalcium Phosphate and Kieselguhr, Combined Use of .. 166
Direct Consumption Sugars for British Public, Suggestion as to .. 441
Disease of Sugar Cane in Porto Rico, New 524
Disease of Sugar Cane, Rind .. 154, 369
Disease, Geographical Distribution of Rind 369
Disease, Cane, in Porto Rico .. 366
Diseases, Deficiency (*P*) 130
Dividends, Various .. 106
Domestic Preserving, Sugar Requirements for, in United Kingdom 279, 293, 409
Double Curing Systems in the Centrifugal House .. 299
Double Polarization, Simplified Inversion Process for Determination of Sucrose by .. 31, 176
Drawback on Export of Sugar, U.S.A... 438, 444
Dry Lime Process, Weinrich's .. 450
Drying Fruit, Efforts to popularize (*P*) .. 276

Eastick, The late J. J. 470
Easton, H. F. .. 185, 205
Easton, The late H. F. 372
Eckart's Weed-Killing Invention .. 455
Egypt, Excise Duty on Sugar in (*P*) .. 570
Electric Power in Sugar Factories— 106, 131, 169, 219, 270
Electrification of Sugar Cane Mills 232, 316
Electrified British Sugar Factories, Two (*Illustrated*) .. 356
Elevating and Automatic Conveying Machinery .. 73
Empire, Sugar Supply of the Lecture by C Sandbach Parker .. 258
Empire, Sugar Supply of the, Society of Chemical Industry Committee 201
Engineering Organization .. 52
English Taste in Sugar 441
Entomology in Porto Rico .. 366
Entrainment Losses, Estimation of 26
Evaporator Condensers, Volume of Air in 23
Evaporator Design and Operation, Some Minor Features of .. 301
Evaporator Practice in Hawaii 72
Evaporators, Air and Incondensible Gases in Effect .. 182
Evaporators Measuring the Heating Surface of: New Hawaiian Standard 523
Examination Papers for Chemists in Mauritius .. 319
Excess Profit Duties on Sugar Estates . .. 153
Experiment Station Enterprise in Java . 85
Experiment Station opened by Cuba Cane Sugar Corporation (*P*) . 158
Experiment Stations, The Queensland. 1915-16 Season . 117
Extraction, Formulae for Computing Mill 401
Extraction of Sugar from Final Molasses— 159, 297, 404, 568

Factories, American Output of Sugar 202
Fehling's Solution, Pentose and Glutose Determinations with .. 275
Female Labour in Refineries 394
Fertilizers, Increasing Use in Hawaii (*P*) .. 482
Fertilizer Standards in Canada (*P*) . 136
Fertilizing Value of Sodium-ammonium Sulphate (*P*) .. 28
Filter-Press Design, Faulty (*Illustrated*) .. 167
Filter-presses as used in Hawaii 72
Filter-presses, Processes where Total Clarified Juice goes through 125, 162, 223, 259
Filter-press, Experiments with a .. 129, 165
Filter-press Manufacturers' Combine in United States (*P*) .. 248
Filtration (*Illustrated*) .. 79, 280
Financial Aid for West Indian Sugar Factories 51
Fire, An American Refinery .. 344
Fire and Explosion in a Sugar Works (*P*) .. 274

General Index.

PAGE
Fly Poisons (*P*) .. 524
Fohebur Filter, The (*Illustrated*) .. 82
Food consumed within the U.K.: Statistics 470
Food Controller, The .. 1, 150, 341
Food Rationing .. 101, 150, 200, 534
Food Supplies, Control of the— 1, 50, 101, 150, 341, 485
Food Supplies, Control of the, in America— 454, 486
Ford's New Agricultural Motor Tractor .. 491
Formosa, Statistics of Centrifugal Sugar Production (*P*) .. 524
Formulae expressing the Efficiency of Milling .. 510
Formulae for Mill Control, Simple .. 227
France denounces the Brussels Convention 442
France: Results of the Campaign of 1915-16 29
France: The Campaign of 1916-17 .. 567
French Crop Figures .. 347
French Sugar Properties freed from the Enemy .. 363, 489
Fribourg, Charles .. 125, 162, 223, 259
Froberville, L. F. de .. 510
"Frothy Fermentation" of Massecuites .. 264
Fruit Crop, Allotment of Sugar for preserving the Private (*P*) .. 279
Fruit Drying, Attempt to popularize (*P*) .. 276
Fuel Value of Bagasse .. 28
Furnaces as used in Hawaii .. 71

Gases in Effect Evaporators, Air and Incondensible (*Illustrated*) .. 182
Geerligs, H. C. Prinsen .. 159, 404
George, Mr Lloyd: View on Imperial Preference .. 198
German Alcohol Industry, Prospects of the 279
"German East Africa": Openings for Trade (*P*) .. 269
German Factories in America renamed (*P*) 371
German Sugar and British Markets .. 389
Germany reported Short of Phosphates (*P*) 523
Germany's Sources of Sulphur Supply. (P) 375
Germany's Substitute for Glycerin . (*P*) 524
Giffard, W H .. 506
Gillet, René .. 264
Glasgow, History of the Sugar Machinery Industry in .. 57, 112
Glucose, Antiseptic Value in Veterinary Operations (*P*) .. 158
Glucose for making Jam. Suggested Danger 524
Glucose as War Substitute for Sugar (*P*) . 85
Glutose Determination by Means of Fehling's Solution .. 275
Glycerin produced from By-Products of Army Catering (*P*) .. 570
Government Control of Trade: Private Criticism .. 545
Government Financial Aid for West Indian Factories .. 51, 247, 343
Government Support for Home Beet Sugar Industry .. 103, 200, 350
Guatemalan Sugar Industry .. 566

Hall, A D: Government Appointment.. 154
Hamill, James . 23, 87, 182, 231, 301, 550
Hardness and its Relation to Wear, Metal.. 548
Harvey, Robert .. 57, 112
Hawaiian Chemists' Association: Methods of Chemical Control . 37
Hawaiian Sugars not up to Standard of Cuban Raws (*P*) .. 482
Hawaiian Use of Fertilizers increasing (*P*) 482
Hawaii, Cane Value for the 1916 Crop (*P*) .. 257
Hawaii: Modern Practice on the Mechanical Side of Sugar Production .. 70
Hawaii: New Method of Weed-Killing in Cane Fields .. 455
Hawaii, Official Figures of Sugar Production (*P*) .. 257
Hawaii, Prolonged Drought in (*P*) .. 502
Hawaii's Cane Sugar Industry. Official Report on .. 420, 464
Hawaii's Prosperity .. 53

PAGE
Hazewinkel, J. J., Death of (*P*) .. 222
Heaters, Juice (*Illustrated*) .. 216
Heating Surface of Evaporators, Measuring 523
Herzfeld's Institute for the Sugar Industry, Jubilee of (*P*) .. 375
Hind, R. Renton .. 70
History of the Sugar Machinery Industry in Glasgow .. 57, 112
Horse Power *v.* Mechanical Tractor in United States .. 345
Hughes, E. B. .. 227

Illingworth, J. F., to investigate Cane Trouble in Queensland .. 276
Ilo Ilo Sugar in London (*P*) .. 375
Imperial Preference accepted .. 198
Imperial Preference: Government Committee Resolution .. 102, 110
Imperial Trade, Plans for .. 390
Impurities in Raw Sugar— 245, 253, 294, 440, 442, 471
Indanthrene Blue superseded by Chloranthrene Blue (*P*) .. 111
Indanthrene compared with Ultramarine in Java (*P*) .. 374
Indentured Indian Labour, A Substitute for .. 392
India: Cane Cultivation in Non-Tropical Parts .. 61
India: First Cane Crop Forecast for 1917-18 482
Indian Labour, A Substitute for Indentured 392
Industry, The Defence of.. .. 249, 396, 492, 540
Industries, After-war .. 535
International Sugar Committee, American- 437, 446, 486
International Sugar Committee, American Criticism of .. 536
Inversion Process, A Simplified, for Double Polarization Determination of Sucrose- 31, 176
Irvine, J. C... .. 321
Italian Restrictions on Trade in Sulphur 347

Jamaica Department of Agriculture Report .. 425
Jamaica. Government-Aided Centrals 247, 343
Jamaica, Introduction of Uba Cane into .. 394
Jam Makers, Supplies of Sugar for Private .. 86, 279, 293, 409
Japan and Formosa: Statistics of Sugar Production (*P*) .. 472
Japanese Capitalistic Ventures in Manchuria (*P*) .. 179
Japanese Sugar Industry. British Report, . 326
Japan increasing her Output of Sulphur (*P*) 521
Java Consular Report .. 473
Java Crop largely bought by the Royal Commission (*P*) .. 363
Java, Experiment Station Enterprise in .. 85
Java, Glut of Sugar in (*P*) .. 424
Jet Condensers, Single.. .. 15
Johnson, J R. .. 369
Juice Filtration .. 280
Juice Heaters (*Illustrated*) .. 216
Juice Heaters as used in Hawaii .. 72
Juice, Purity affecting Centrifugal, Crystallizer, and Pan Capacity .. 351
Juice Strainers as used in Hawaii .. 71
Juice, Total Clarified, passing through Filter-presses .. 125, 162, 223, 259

Kelham Sugar Factory, The new.. 200, 247, 395
Kelham Sugar Factory: Development Commissioners' Grant (*P*) .. 350
Key Industries, After-War Protection of .. 535
Kieselguhr, Combined Use of Di-Calcium Phosphate and .. 166
Kieselguhrs, Analyses of Varieties of.. .. 162
Knives, Revolving, as used in Hawaii .. 70
Kopke, E. .. 70
Koppeschaar, Ed. .. 188
Korean and Manchurean Sugar Industry.. 247

PAGE
Labour Problems after the War 392
Labour, Substitute for Indentured Indian 392
Lee, H. W. van der 131, 169, 219, 270
Leeward Islands : Colonial Report 86
Leeward Islands : Manurial Experiments 360
Lime in Cane Cultivation, Effect of 312
Lime Process of making White Sugar, Weinrich's Dry 450
Liming of Limy Lands, The 209
Liquids and Solids, Mixtures of 419
Losses by Marine Risks (*P*) 279
Louisiana : Official American Report on Cane Industry 557
Louisiana Situation over Sugar Supply, The 537
Lovibond Tintometer, The 306
Luce Harvesting Machine, in Use in Cuba 482

Machinery, British *v.* American Sugar 6, 88
Machinery Industry after the War, The Sugar 42
Machinery Industry in Glasgow, History of the Sugar 57, 112
Manchuria, Japanese Projects in (*P*) 179
Manchurean and Corean Sugar Industry 247
Margin, The Refiners', in United States 438
Manurial Experiments in the Leeward Islands 360
Market Report, Sugar 48, 244, 484
Martineau, George : Brief History of Sugar 157
Martineau, George 107, 249, 396, 444, 492, 540
Massecuites, "Frothy Fermentation" of 264
Mauritius. Examination Papers for Chemists 319
Mechanical Side of Sugar Production in Hawaii 70
Metal Hardness and its Relation to Wear 548
Mill, A Unique Old British Cane (*Illustrated*) 65
Mill Control, Simple Formulae for 227
Mill Extraction, Formulae for computing 401
Milling, Formulae expressing Efficiency of 510
Mirrlees Mill, A Unique Old (*Illustrated*) 65
Mixtures of Liquids and Solids 419
Molasses, Black Stroop, fetching High Prices in America (*P*) 426
Molasses, Extraction of Sugar from Final— 159, 297, 404, 568
Molasses used in Production of Potash and Acetates (*P*) 513
Molasses, Waste, Utilization of, in Queensland 347
Molassine Co.'s Works : Explosion and Fire 274
Moroney, C. J. 42
Motor Spirit made from Mhowra Tree in India (*P*) 305
Motor Tractor, A cheap Agricultural 491
Motor Tractor *versus* Horse in United States : Comparative Costs 345
Mulgrave Central Mill Co.'s Report (*P*) 570

Natal Sugar Industry : An Official Summary 346
Natal : Taxation of Sugar (*P*) 305
Nitro-starch, Advantages as an Explosive 374
Norit Process of Refining in a Beet Factory 506
Norris, R. S. 523

Obituary 320, 372. 470
Observation Tubes for Saccharimeters, New 76
Ogilvie, J. P. 450

Paints, Action of Calorific Rays on various (*P*) 229
Pan Capacity as affected by the Purity of the Juice 351
Parker, C. Sandbach, on Sugar Supply of Empire 258
Peat, Bacterized 168, 417
Pellet, H 35, 76, 176, 275, 367
Pentoses, Determination of, by Fehling's Solution 275
Peru, Field and Factory Work in 230
Peru's Sugar Production 54
Pharmacopœia, The British. Interdicted Compounds containing Sugar 424

PAGE
Phosphates, Dicalcium 162, 166
Phosphates, Experiments with Soluble 127
Phosphates, Shortage reported in Germany 523
Phospho-gelose, Composition of 223
Phospho-gelose, Industrial Use of 261
Phosphoric Acid, New Process for manufacturing (*P*) 85
Philippines, Progress in the 490
Philippine Sugar, Stagnation of Export (*P*) 482
Piping for Evaporators, Pans, and Stills, Vapour 78
Plantation White Sugars, Scope for Sale in the United Kingdom 441
Planting Cane in Single and Double Row 20
Porto Rico, Experimental Work in 364
Porto Rico, New Cane Disease reported (P) 524
Porto Rico, Official Report on Sugar Industry 466
Potash Deposits in Russia, Discovery of 512
Potash extracted from Waste Molasses (*P*). 513
Potash Output of the United States (*P*) 368
Potash, Scarcity of through the War (*P*) 570
Precipitates in White Sugar Manufacture, Composition of Syrup 35
Preference, Imperial 102, 110, 198
Preserving, Sugar for : Demand in the United Kingdom 86, 279, 293, 409
Prices of Sugar in U.S. 537
Prices of Sugar in U.S. Market, Controlled 438
Prices of Sugar, Retail, in United States (*P*) 248
Price of Sugar, The High 107
Prices of Sugar within the United Kingdom, Retail (*P*) 408
Pumps, Centrifugal, in the Sugar Factory 550
Pumps in Sugar Houses 66
Purity, Coefficient of : Increase caused by Clarification 367
Purity of Juice affecting Centrifugal, Crystallizer, and Pan Capacity 351
Purity of Sugar and Water Content, Relation between 42

Queensland, Capital and Labour in 391
Queensland : Engagement of Prof. Illingworth to investigate Cane Beetle Trouble (*P*) 276
Queensland, New "Babinda" and "South Johnston Centrals (*Illustrated*) 356
Queensland Sugar Experiment Stations : 1915-16 Season 117
Queensland, Utilization of Waste Molasses 347

Rationing, Food 101, 150, 200, 534
Rationing of Sugar Consumption in United Kingdom 342, 485, 534, 544
Rationing of Sugar Users (*P*) 279
Rationing, Sugar Amended Arrangements 534, 544
Raw Sugar, Impurities in – 245, 253, 294, 440, 442, 471
Raw *versus* Refined Sugar 245
Refineries, Female Labour in 394
Refiners' Advertisement, An Old-Time (*Illustrated*) 514
Refiners in United States market a Raw Sugar 440
Refiners' View of the Drawback Question in United States 439
Refinery Fire, An American 344
Refining, Increased Cost in United States 375
Registration of Business Names 105
Renton, G. A. 78, 87, 188
Rhondda, Lord 341
Rind Disease of Sugar Cane 154
Rind Disease, Geographical Distribution of 369
Roche, R 415
Rolph, G. M., American Sugar Administrator 395, 437, 446
Rosenfeld, A. H. 20, 209, 509
Royal Commission for Sugar Supply : Operations 136, 363, 371, 406, 443, 457, 488
Royal Commission for Sugar Supply : Chairman 407
Royle, C. L. 230

General Index.

PAGE
Russian Sugar Notes 11, 214, 304, 448
Russia, Suspension of Restrictions on Saccharin (*P*) .. 191
Russia, Temporary Remission of Import Duty on Sugar (*P*) .. 9

Saccharimeters, New Observation Tubes for (*Illustrated*) .. 76
Saccharin in Jam : Medical Warning (*P*) .. 524
Saccharin, Suspension of Restrictions on Use in Russia (*P*) .. 191
Salicylic Acid with Jam : Medical Warning 524
Saturation, The Economic Limit of 503
Scales, Cane, as used in Hawaii .. 70
Searby Shredder, The .. 71
"Seed," Use of Tops as .. 415
Settling Tanks as used in Hawaii .. 72
Shipping Sugar in own Vessels, Advantage of (*P*) .. 158
Siberia : Proposed Beet Cultivation (*P*) 77
Society of Chemical Industry : Sugar Supply Committee .. 201
Sodium-ammonium Sulphate, Fertilizing Value of (*P*) .. 28
Soil Aeration in Agriculture .. 3
Soil, Cuba's 152
Solar Ovens as Fuel Economizers (*P*) 375
Solids and Liquids, Mixtures of .. 419
South Johnston and Babinda Centrals, Queensland (*Illustrated*) .. 356
Spain, Sugar Production in 1916 373
Spirit, Motor, from Mhowra Tree in India 305
Steam, Properties of Saturated .. 18
Steam, Superheated, in the Sugar Factory— 354, 409
Steamship Service via Panama to Australasia, Proposed (*P*) .. 375
Stewart Central, Cuba (*Illustrated*) 180
Strainers, Juice, in Hawaii .. 71
Stripping Sugar Cane by Hand before Planting .. 509
Studies in Cane Sugar Manufacture— 125, 162, 223, 259
Sucrose Determination by Double Polarization, Inversion Process for 31, 176
Sugar Cards, The Advent of 342, 485
Sugar Determination with Alpha-Naphthol 26
Sugar for Preserving, Demand in the U K for .. 86, 279, 293, 409
Sugar from Final Molasses, Extraction of— 159, 297, 404, 568
Sugar, Impurities in Raw— 245, 253, 294, 440, 442, 471
Sugar Machinery Industry after the War, 42
Sugar Market Report .. 48, 244, 484
Sugar Rationing Amended Arrangements .. 534, 544
Sugar, Raw *versus* Refined .. 245
Sugar Situation · Official American Report 486
Sugar Supply, Royal Commission on— 136, 363, 371, 408, 443, 457, 488
Sugar Supply of the Empire .. 201, 258
Sugar Supply, The, of the United Kingdom 293
Sugar, The English Taste in .. 441
Sugar, The High Price of .. 107
Sugar Trade, Government Control of : a Criticism .. 545
Sugar Trade of 1916 in United Kingdom 13, 320
Sugar Users, Further Restrictions in Supply to (*P*) .. 279
Sulphi-phosphatation, Experiments in .. 126
Sulphuric Acid, German Sources of Supply 375
Sulphur, Increased Production in Japan (*P*) 524
Supplies and Renewals : A War Time Necessity .. 488
Sutton, The late Francis (*P*) .. 215
Swiss Manufacture of Alcohol from Calcium Carbide (*P*) .. 524
Syrup Purity and Water Content, Relation between .. 42

Tare on Sugar Beet .. 205
Taxes on Sugar Estates, Excess Profit 153
Tintometer, Application of, to Factory and Refinery Control .. 306

PAGE
Tops as "Seed" for planting Sugar Cane .. 415
Trade, Plans for Imperial .. 390
Trade, Government Control of Sugar : A Criticism .. 545
Trade Marks for British Goods (*P*) .. 279
Tucumán Experiment Station, Cane Varieties at .. 562
Tucumán Sugar Experiment Station, The Work of .. 513

Uba Cane, Introduction into Jamaica .. 394
U-Boats, Losses in Sugar Ships from .. 293, 395
Ultramarine compared with Indanthrene 374
United Fruit Co.'s Shipping Advantages (*P*) 158
United Kingdom, Beet Sugar Production in 49, 65, 103, 149, 155, 185, 200, 247, 395
United Kingdom : New Era for Agriculture 2
United Kingdom : Statistics of Food Consumption (*P*) .. 470
United Kingdom · Sugar Trade of 1916 .. 13, 320
United Kingdom : The Sugar Consumption 50, 293, 341, 348
United Kingdom : Wholesale Distribution of Sugar in .. 51
United States *See also under* America.
United States Beet Sugar Industry : Federal Commission Report .. 410
United States Domestic Beet Industry .. 10, 413
United States Food Administration : Official Surveys .. 454, 486
United States Government Control of Sugar 437
United States, Government Control of Sugar, Extent of .. 487
United States, Imports of Russian Beet Seed (*P*) .. 502
United States, Impure Sugar in .. 440
United States, Increased Cost of Refining 375
United States, Increased Production of Beet Seed in (*P*) .. 179
United States, International Sugar Committee .. 437, 446, 486
United States, Retail Prices of Sugar in .. 248
United States, Temporary Scarcity of Sugar 502
United States, The Drawback Question 438, 441
Unloaders in Use in Hawaii .. 70

Vacuum Pans as used in Hawaii .. 72
Vapour Piping of Evaporators, Pans, and Stills .. 78
Verein der Deutschen Zuckerindustrie and British Markets .. 389

Walker, Herbert S. .. 31
Walton, The late Thomas U. .. 320
War, The .. 48, 341
War, The · America's Decision .. 197
Waste Molasses in Queensland, Utilization of .. 347
Water Content and Purity of Syrup, Relation between .. 42
Watts, Hon. Francis, the Recipient of a K.C.M.G (*P*) .. 154
Wax from Sugar Cane in Natal (*P*) .. 561
Weed-killing in Cane Fields, Eckart's New Method of .. 455
Weinrich, M. .. 406
Weinrich's Dry Lime Process .. 450
West Indian Sugar Factories, Government Financial Aid for .. 51, 247, 343
West Indies, Canada and the .. 152
White Sugar Manufacture, Composition of Precipitates obtained from Syrups in . 35
White Sugar Manufacture . Making of Decolorizing Carbon for .. 511
White Sugars : Scope for increasing Consumption in U.K. .. 441
White Sugar, Weinrich's Dry Lime Process of making .. 450
Willett, Death of W. P. .. 570
Williams, J. N. S. .. 297, 568
World, Sugar Crops of the .. 96, 195, 387, 579

PUBLICATIONS RECEIVED.

SUBJECT MATTER.

PAGE

Applied Chemistry, Progress of. Society Chemical Industry 374

Bayley's Chemists' Pocket Book. Ensoll, R. 329

Cana de Azucar en Cuba, Cultivo de la. Crawley, J. T. 329
Cane Sugar Manufacturers, Handbook for. Spencer, G. L. 232
Chemical Engineering Catalogue 233
Chemical Industry, Annual Reports of Society of 374
Chemists' Pocket Book. International Correspondence Schools 472
Chemists' Pocket Book, Bayley's. Ensoll, R. 329
Colour and Light Theories. Lovibond, J. W. 278
Concerning Sugar. Palmer, T. G 522
Control, Handbook of Milling. Proefstation, Java 328

Empire, Sugar Supply of the. Parker, C. S. 374
Engineering Catalogue, Chemical 233

Fabriques de Sucre, Liste Générale des 472
Factory Control, The Overseer and. Fletcher & Co, Ltd. 189
Fertilizers, Phosphate, for Hawaiian Soils. McGeorge, W. T. 329

Government Chemist, Report for 1916 on Government Laboratory 328
Green Manures and Manuring in the Tropics. Sornay and Flattely 277

Handbook for Cane Sugar Manufacturers Spencer, G L 232
Handbook of Tropical White Sugar Manufacture Harloff and Schmidt 327
History of Sugar 1856-1916 Martineau, G 373

Insects and their Control, Scale. Cotton, R. T. 522
Irrigation Wood, R C 522
Irrigation, List of U.S.A Government Publications on 522
Irrigation of Sugar Beets. Harris, F S. 522

Laboratory, Report on the Government, for 1915-16 328
Light and Colour Theories Lovibond, J. W. 278
Liste Générale des Fabriques de Sucre 472
Logarithms, A B C Five-Figure. Woodward, C. J. 277

Manures and Manuring in the Tropics, Green. Sornay and Flattely 27
Mauritius Almanac, The. Walter, A. 18
Milling Control, Handbook of. Proefstation, Java 32

Oils, U.S. Standard Tables for Petroleum 32
Overseer and Sugar Factory Control. Fletcher & Co., Ltd. 18

Phosphate Fertilizers for Hawaiian Soils. McGeorge, W. T. 32
Plant Growth, Soil Conditions and. Russell, E. J. 52
Pocket Book, Bayley's Chemists'. Ensoll, R. 32
Pocket Book, Chemists'. International Correspondence Schools 47
Production of Sugar in United States and Foreign Countries. Elliott, P. 32

Saltpetre: Its Origin and Extraction in India. Hutchinson, G. M. 32
Scale Insects and their Control. Cotton, R. T. 52
Society of Chemical Industry: Annual Reports on Applied Chemistry 374
Soil Conditions and Plant Growth. Russell, E. J. 521
Sorghums, Digestibility of the Grain. Langworthy and Holmes 329
Specific Gravity of Sugar Solutions, Tables showing 233
Sugar, A Short History of, 1856-1916. Martineau, G. 373
Sugar Cane to Sugar Bowl, From. Warner Sugar Refining Co. 189
Sugar, Concerning. Palmer, T G. 522
Sugar Production in U.S A and Foreign Countries. Elliott, P. 329
Sugar Supply of the Empire. Parker, C. S. 374

Tables showing Specific Gravity of Sugar Solutions 233
Transpiration as a Factor in Crop Production. Kiesselbach, T A. 522

United States. List of Government Publications relating to Plants, Agricultural Chemistry, etc. 329, 522

White Sugar Manufacture, Handbook of Tropical. Harloff and Schmidt 327

NAMES.

Bayley, Chemists' Pocket Book 329
Crawley, J. T. Cultivo de la Cana de Azucar en Cuba 329
Cotton, R. T. Scale Insects and their Control 522
Elliott, P. Production of Sugar in U.S.A. and Foreign Countries 329
Ensoll, R. Bayley's Chemists' Pocket Book 329
Fletcher & Co., Ltd. The Overseer and Sugar Factory Control 189
Flattely, F W. Green Manures and Manuring in the Tropics 277
Harloff, W. H. T. Handbook of Tropical White Sugar Manufacture 327
Harris, F. S. Irrigation of Sugar Beets 522
Holmes, A. D. Studies in the Digestibility of the Grain Sorghums 329
Hutchinson, G. M. Saltpetre: Its Origin and Extraction in India 329
Kiesselbach, T. A. Transpiration as a Factor in Crop Production 522

Langworthy, C. F Studies in the Digestibility of the Grain Sorghums 329
Lovibond, J W Light and Colour Theories 278

Martineau, G. A Short History of Sugar, 1856-1916. A Warning 373
McGeorge, W. T Phosphate Fertilizers for Hawaiian Soils 329

Palmer, T. G. Concerning Sugar 522
Parker, C S. Sugar Supply of the Empire 374

Russell, E. J Soil Conditions and Plant Growth 521

Sornay, P de. Green Manures and Manuring in the Tropics 277
Spencer, G. L. Handbook for Cane Sugar Manufacturers 232

Walter, A. The Mauritius Almanac 189
Wood, R. C. Irrigation 522
Woodward, C. J. A B C Five-Figure Logarithms for Chemists 277

REVIEW OF CURRENT TECHNICAL LITERATURE.

SUBJECT MATTER.

PAGE

Acetic Acid and Acetone, their Manufacture from Sucrose by Bacteria. G. Mezzadroli 571
After-ripening of Cane. J. H. Barnes 333
Agriculture and the Use of Electricity. I. Jorgensen 429
Aldehydes: their Detection. Anon. 527
American Beets, their Marc Content. C. J. Bourbakis 334
Ammonium Sulphate in Cane Cultivation. J. M Geerts, 45, 335; C. H. van H. Lako 280
Analysis of Soils. C H van H. Lako 44
Auximones in "Bacterized Peat." W. B. Bottomley, 429; O. Rosenheim 527
Apparatus, Glass: its Testing. Anon. .. 378
Apple: its Levulose Content. J. R. Eoff .. 381

Bacteria: their Use in the Manufacture of Acetic and Lactic Acids and Acetone from Sucrose. G. Mezzadroli .. . 571
"Bacterized Peat." J. W. Tocher, 284; W. B Bottomley, 429; O Rosenheim .. 527
Bagasse Furnaces in Hawaiian Factories R. R. Hind and E. Kopke . . 284
Basic Lead Acetate, and the Nature of the Substances it precipitates H Pellet 334
Basic Lead Acetate, Polarization without its Use. H. Pellet 526
Beet Cutworm Pest in California G E. Bensel 236
Beet Diseases G. E. Bensel. 236, H B Shaw, 475, V. W. Pool and M B McKay 476
Beet Pulp Desiccation L Malpeaux . 43
Beets, Marc Content C J Bourbakis ... 334
Blue in Sugars in Canada A McGill 236
Boilers in Hawaiian Factories. R. R Hind and E Kopke 284

Cake and Pastry Order, the Determination of Sugar in Baked Articles. Anon. 525
Calcium Cyanamide *vs* Sulphate of Ammonia J M Geerts .. . 573
Cane, and the Relation between its Colour and Maturity. A M P A Scheltema 574
Cane Borer in Java P. van der Goot 378
Cane Cultivation and the Mechanical Analysis of Soils. C. H. van H Lako 44
Cane Diseases. P. van der Goot, 378, E Jarvis, 430, J Groenewege . 572
Cane in Queensland Anon, 92, E Jarvis. 430
Cane: its After-ripening J H. Barnes . 333
Cane, Japanese J N Scott 285
Cane Manuring in Java J M. Geerts, 45, C H van H Lako, 280, J. M Geerts .. 335
Cane Planting after Stripping. W E. Cross 332
Cane Transport in Hawaii. R. R. Hind and E Kopke 283
Cane Varieties in Java J. Jeswiet . 44
Cane Varieties in Mauritius. H Robert .. 379
"Caramels" and other Confectionery containing Paraffin Wax A McGill .. 475
Centrifugals and Crystallizers in Hawaii. G. F. Winter, 234, R. R Hind and E. Kopke . .. 284
Centrifugal Work in Hawaii. J. H Pratt 89
Cercospora beticola. V M. Pool and M. B. McKay 476
Clarification in Hawaiian Factories R. R. Hind and E. Kopke 284
Clerget Method. C. A Browne 139
Colloidal Cuprous Oxide in determining Reducing Sugars D. Sidersky .. 574
Colouring Substances for Food; their Identification. W. E. Mathewson .. 381
Confectionery containing Paraffin Wax A. McGill 475

PAGE

Constants of the Quartz-wedge Saccharimeter. F. Bates and R. F. Jackson .. 380
Constitution of Sucrose. W. N. Haworth and J. Law 235
Crystallizers and Centrifugals in Hawaii. G. F. Winter, 234; R R. Hind and E. Kopke 284
Cuprous Oxide, Colloidal, in determining Reducing Sugars. D Sidersky . . 574
Curing in Hawaii. R. R Hind and E. Kopke 274
Curing of Massecuite. J H. Pratt .. 89

Desiccation of Beet Pulp. L. Malpeaux.. 43
Dextrose: its Saccharimetric Normal Weight R. F Jackson .. 378
Disaccharides, their Constitution. W. N. Haworth and J Law 235
Diseases of the Cane. P. van der Goot, 378; E. Jarvis, 430, J. Groenewege ... 572
Diseases of the Beet G E Bensel, 236; H. B. Shaw, 475, V. W. Pool and M. B. McKay 476
Double Polarization Method, its Modification. C. A Browne 139

Electricity and Plant Production. I. Jorgensen 429
Evaporation in Hawaiian Factories. R. R. Hind and E Kopke . . 284
Evaporation by Thermo-compression Anon 137
Extraction of Sugar from Molasses by Williams' Process. J N. S. Williams .. 90

Fermentation and Destruction of Pentoses. H Pellet 141
Fermentation, its Mechanism A Fernbach 527
Fertilizers, their Loss by Leaching S. E. Collinson and S S Walker 380
Fibre Content of Beets E. J Bourbakis .. 334
Filter-paper E J Bevan and W. Bacon . 334
Furnaces in Hawaiian Factories R R. Hind and E Kopke 284

Glass Volumetric Apparatus, its Testing . 378
Glucose as Veterinary Dressing G Bussano 43
Glucose Determination L Grimbert. 190, G P Meade and J B Harris, 527; Anon 574
Glucose precipitated by Basic Lead Acetate H Pellet .. 334
Glucose, *see also* Invert Sugar *and* Reducing Sugars
Glutose in Cane Molasses H Pellet 141, 334 430
Grooving Mill Rollers J H Dod 234
Gunthorpes Factory, Antigua, B W I. its Mill Work Sir F. Watts 473

Hawaiian Methods of Curing J H. Pratt 89
Hawaiian Methods of Sugar Manufacture. R R Hind and E Kopke . 283
Hawaiian Report upon Crystallizers and Centrifugals G F. Winter . . 234
Honey Examination W. R G Atkins 376

Icing Sugars in Canada A McGill . . . 236
Inherited Stem Characters in Sorghum. G. R Hilson . . . 335
Invertase as Hydrolyst in Double Polarization Method. C A. Browne 139
Invertase, its Presence in Sugars H. Pellet 330
Invert Sugar Determination. G P. Meade and J. B Harris, 527, Anon .. 574
Invert Sugar, *see also* Reducing Sugars, *and* Glucose

Index.

PAGE

Jam Examination. W. R. G. Aitkens 376
Japanese Cane. J. M. Scott 285
Java Cane Varieties. J. Jeswiet, 44; A. M. P. A. Scheltema 574
Java, and Cane Borers. P van der Goot 378
Java, and the Nitrogenous Manuring of the Cane. J. M. Geerts, 45; C. H. van H. Lako, 280; A. M. P A. Scheltema ... 574
Juice Clarification in Hawaii. R. R. Hind and E. Kopke 284
Juice Extraction in Hawaii. R. R. Hind and E. Kopke 283
Juice Preservation for Analysis. E. Pitot 43

Lactic and Acetic Acids, their Manufacture from Sucrose by Bacteria. G. Mezzadroli 571
Leaching of Fertilizers. S. E. Collinson and S. S. Walker 380
Lead Acetate, Basic, Polarization without its Use. H. Pellet 526
Lead Acetate, Basic, and the Nature of the Substances it precipitates. H. Pellet .. 334
Lehmann's Method of determining Reducing Sugars. L. Grimbert 190
Levulose in Apple Juice J. R. Eoff . .. 381
Levulose Determination. L. Loewe 92
Lime required for Soil Sterilization. H A. Tempany 427

Magnesium Pyrophosphate, its Ignition. S. H. Champlin . . 43
Magnesium Sulphate, its Use in removing Colloidal Cuprous Oxide. D Sidersky. 574
Manuring of Cane in Java. J. M Geerts, 45; C. H van H Lako 280
Manure Manufacture by carbonizing Molasses J. W. Reed . . 190
Marc Content of Beets. C J. Bourbakis 334
Massecuite Curing in Hawaii. J H. Pratt 89
Mauritius Cane Varieties. H Robert 379
Mechanical Analysis of Soils in Java C. H. van H Lako . . 44
Mill Roller Grooving. J. H. Dod . 234
Milling in Hawaii R. R Hind and E Kopke 283
Mill Work in Antigua, B.W.I. Sir F Watts 473
Molasses, Beet, Separation of its Constituents and its Nitrogenous Pigments. H. Friedrich . 574
Molasses Extraction. J. N. S Williams 90
Molasses Fermentation and Pentose Destruction. H. Pellet 141
Molasses Utilization of its Fertilizer Constituents J. H Reed, 190, W E Cross and W. G Harris, 281; H. E. Zitkowski 428
Molasses, Glutose Determination in H. Pellet 430

Nematode in the Beet H. B Shaw.. . 475
New York Sugar Trade Laboratory Report. C. A Browne 141
Nitrate of Soda *vs* Sulphate of Ammonia in Java C H van H Lako, 280; J M Geerts 335
Normal Weight of Dextrose R. F Jackson 378
Normal Weight Constants of Sucrose. F. Bates and R. F. Jackson 380

Pan Steam Regulator. Anon . . 331
Paraffin Wax in Confectionery. A McGill 475
Peat as Fertilizer J. W. Tocher, 284, W. B. Bottomley, 429; O Rosenheim 527
Pentoses during Fermentation. H Pellet. 141
Pentoses, their Determination by Fehling's Solution. J. L. Baker . . 92
Phosphate Determination. S. H. Champlin 43
Phosphates in Agriculture, a Criticism N. A. Barbieri 430
Pigments of Beet Molasses. H Friedrich . 574
Plant Production and the Use of Electricity. I. Jorgensen 429
Polarization of Sugars. C. A. Browne, 141, L. Baissac 141
Polarization of Sugar Products without Lead Acetate. H. Pellet 52
Polarimetric Readings. L. Baissac 14
Potash Fertilizer from Cane Molasses. J. W. Reed, 190; W. E. Cross and W. G. Harris, 281; H. E. Zitkowski 42
Potash from Blast Furnace Flue Dust. H. T Cranfield.. 57
Potash, its Manufacture from Felspar. Anon 47
Preservation of Juice. E. Pitot.. 4
Pulp Desiccation. L. Malpeaux 4
Pumps in Hawaiian Factories. R. R. Hind and E. Kopke.. 28

Queensland Cane Cultivation. Anon, 92; E. Jarvis 43

Reducing Sugars, *see also* Glucose, *and* Invert Sugar.
Reducing Sugars Determination. G. P. Meade and J B. Harris, 527; Anon. .. 57
Reducing Sugars Determination by Lehmann's Method. L. Grimbert 19
Reducing Substances precipitated by Basic Lead Acetate, their Nature. H. Pellet 33
Regulator for Vacuum Pans. Anon. 331
Roller Grooving. J. H. Dod.. 23

Saccharimeter Constants. F. Bates and R F Jackson 38
Saccharimetric Readings. L. Baissac 141
Söderlund and Boberg System of Evaporation by Thermo-compression. Anon . 137
Soil Analysis in Java. C. H. van H. Lako . 44
Sorghum, and Inherited Stem Characters. G R Hilson 33
Steam Regulator for Pans. Anon 331
Steffen's Waste Water, its Use for Recovery of Potash H. E Zitkowski 428
Stripping Cane before Planting. W. E. Cross 332
Sucrose, its Conversion to Lactic and Acetic Acids and Acetone by Bacteria G Mezzadroli 571
Sucrose, its Structure W. H Haworth and J Law 235
Sucrose, its Specific Rotation and Normal Weight Constants. F Bates and R. F. Jackson 380
Sugars in Canada A McGill 236
Sugar containing Invertase H. Pellet . 330
Sugars as Veterinary Dressing G. Bussano 43
Sugars, their Polarization. C. A Browne, 141, L Baissac 141
Sugar Extraction from Molasses by Williams' Process. J N S Williams . . 90
Sugar Syrup, its Dilution to a desired Gravity J. B McNair . . . 376
Sulphate of Ammonia in Cane Cultivation. J. M Geerts, 45, 335, 573, C. H. van H Lako 280
Superphosphates in Agriculture, a Criticism N A Barbieri 430
Syrup, its Dilution to a desired Gravity. J B. McNair 376

Testing Volumetric Glass Apparatus . .. 378
Thermo compression System of Evaporation. Anon 137

Ultramarine Blue in Sugars. A. McGill .. 236

Vacuum Pan Steam Regulator. Anon.... 331
Veterinary Surgery and the Use of Sugar. G Bussano 43
Vinasse Utilization. W. E. Cross and W. G. Harris 281
Volumetric Method of determining Reducing Sugars. L. Grimbert, 190; D. Sidersky 574

Wax in Confectionery. A McGill 475
Williams' Process of Molasses Extraction. J. N. S. Williams 90

Current Technical Literature.

NAMES.

PAGE

Atkins, W. R. G. Determination of Levulose in Honey, Jam, etc. 376

Bacon, W., and Bevan, E. J. Filter-paper 334
Baissac, L. Polarimetric Readings 141
Baker, J. L., and Hulton, H. F. E. Determination of Pentoses 92
Barbieri, N. A. Criticism on Use of Superphosphates 430
Barnes, J. H. After-ripening of Cane 333
Bates, F., and Jackson, R. F. Constants of Quartz-wedge Saccharimeter 380
Bensel, G. E. Cutworm Pest of the Beet 236
Bevan, E. J., and Bacon, W. Filter-paper. 334
Bottomley, W. B. Test for Auximones in "Bacterized Peat." 429
Bourbakis, C. J. Marc in American Beets. 334
Browne, C. A. Double Polarization Process 139
Browne, C. A. Report of New York Sugar Trade Laboratory 141
Bussano, G. Sugar in Veterinary Surgery. 43

Champlin, S. H. Magnesium Pyrophosphate Ignition 43
Collinson, S. E., and Walker, S. S. Leaching of Fertilizers 380
Cranfield, H. T. Potash from Blast Furnace Flue Dust 573
Cross, W. E., and Harris, W. G. Utilization of Molasses 281
Cross, W. E. Stripping Cane before Planting 332

Dod, J. H. Grooving Mill Rollers 234

Eoff, J. R. Levulose in Apple Juice 381

Fernbach, A. Mechanism of Fermentation 527
Friedrich, H. Recovery of Constituents of Beet Molasses 574

Geerts, J. M. Cane Manuring in Java 45
Geerts, J. M. Sulphate of Ammonia and Nitrate of Soda 335
Geerts, J. M. Calcium Cyanamide *vs.* Sulphate of Ammonia 573
Goot, P. van der. Enemies of Cane Borers 378
Grimbert, L. Determination of Reducing Sugars 190
Groenewege, J. Combating Insects injurious to Cane 572

Harreveld-Lako, C. H. van Java Soil Analysis 44
Harreveld-Lako, C. H. van. Manuring with Sulphate of Ammonia 280
Harris, W. G., and Cross, W. E. Utilization of Molasses 281
Harris, J. B., and Meade, G. P. Determination of Reducing Sugars 527
Haworth, W. N., and Law, J. Structure of Sucrose 235
Hind, R. R., and Kopke, E. Sugar Manufacture in Hawaii 283
Hilson, G. R. Stem Characters in Sorghum 335
Hulton, H. F. E., and Baker, J. L. Determination of Pentoses 92

PAGE

Jackson, R. F. Saccharimetric Normal Weight 378
Jackson, R. F., and Bates, F. Constants of Quartz-wedge Saccharimeter 380
Jarvis, E. Coleopteran Cane Pest 430
Jeswiet, J. Cane Varieties of Java. 44
Jorgensen, I. Application of Electricity to Plant Growth 429

Lako, C. H. van H. Java Soil Analysis 44
Lako, C. H. van H. Manuring with Sulphate of Ammonia 280
Law, J., and Haworth, W. N. Structure of Sucrose 235
Loewe, L. Determination of Levulose 92

Malpeaux, L. Beet Pulp Desiccation 43
Mathewson, W. E. Identification of Food Colouring Substances. 381
McGill, A. Sugars in Canada 236
McGill, A. Confectionery containing Paraffin Wax 475
McNair, J. B. Tables for Dilution of Sugar Liquor 376
Meade, G. P., and Harris, J. B. Determination of Reducing Substances 527
Mezzadroli, G. Lactic and Acetic Acids and Acetone from Sugar by Bacteria 571

Pellet, H. Destruction of Pentoses during Fermentation 141
Pellet, H. Determination of Glutose 430
Pellet, H. Invertase in Cane Sugars 330
Pellet, H. Polarization without using Lead Acetate 526
Pellet, H. Reducing Substances precipitated by Basic Acetate 334
Pitot, E. Preservation of Juice 43
Pool, V. W., and McKay, M. B. *Cercospora beticola* 476
Pratt, J. H. Massecuite Curing 89

Reed, J. W. Molasses for Manure 190
Robert, H. Cane Varieties of Mauritius 379
Rosenheim, O. "Bacterized Peat" 527

Scheltema, A. M. P. A. Coloration and Maturation of the Cane 574
Scott, J. M. Japanese Cane 285
Shaw, H. B. Beet Nematode Control 475
Sidersky, D. Colloidal Cuprous Oxide 574

Tempany, H. A. Soil Sterilization 427
Tocher, J. H. "Bacterized Peat." 284

Walker, S. S., and Collinson, S. E. Leaching of Fertilizers 380
Watts, Sir F. Mill Work in Antigua, B.W.I. 473
Williams, J. N. S. Molasses Extraction 90
Winter, G. F. Crystallizers and Centrifugals 234

Zitkowski, H. E. Recovery of Potash from Beet Molasses 428

REVIEW OF PATENTS.

SUBJECT MATTER.

[(U.K.P.) implies United Kingdom Patent; (U.K.A.) United Kingdom Application; (U.S.P.) United States Patent; and (F.P.) French Patent.]

PAGE

Acid Calcium Phosphate Manufacture. B. Leven. (U.K.A.) .. 242
Alcohol Manufacture from the Agave Plant. L. Lavedan. (U K.P.) .. 96
Alcohol Rectification. Soc. E. Barbet et Fils et Cie. (U.K.A.), 291; (U K A.) 386, 578
Alcohol as Fuel, its Ignition. A. J. Stoneman. (U.K.A.) .. 481
Alcohol Manufacture. P. Dreesbach (Corn Products Refining Co.) (U.S P.), 194; (Soc. d'Exploit. Proc. H. Boulard (U.K.A.), 242; G. H. Hughes (U K.A.), 329: Soc. E. Barbet et Fils et Cie. (U.K.A), 386; H. Dreyfus. (U K A.), 481, 578
Alcohol, Solidified, burning Apparatus A. Swiecinski. (U.K A) .. 194
Animal Charcoal Revivification. M. Weinrich (U.K.A.), 45, 382; (U.S.P), 336: R. S. Kent (U S P.) .. 529

"Bacterized Peat." W. B. Bottomley. (U.K.A) .. 97
Baffle-plates for Evaporators. H. Fay. (U.K.A.) .. 339
Bagasse Utilization for Paper Manufacture. M. W. Marsden. (U.S P) .. 238
Beet, its Use in Jam Manufacture C. Chatillon and G Quarré. (U.K.A) .. 481
Beet Diffusion J. Stewart. (U.S P) .. 95
Beet Digger Landrain Frères (U K P) . 290
Beet Harvester. T V. Jensen (U K P), 146, (U.K A) .. 242
Beet Topping Machines Landrain Frères and J H. Jack. (U K.A) .. 194
Belt, Chain. for Cane Mill. J. W. Hyatt. (U.K P) .. 575
Boiler Cleaning Apparatus H. J. Lund. (U K A) .. 45
Boiler Non-conducting Covers. W. P. Wrightson (U K A) .. 194
Boiler Scale Removal or Prevention Cie. Gén Détartrage (U K P.), 193, 242, E. Makin (U K.A,), 194 J. M. J Coadie (U K A) .. 481
Boiler Smoke Consumption. G Watson (U.K.A) .. 97
Boilers. Circulators Ltd (U K A), 97, J P Davies (U K.A), 97; H G C. Fairweather (U K.P), 146, D T. Scott (U K.A.) .. 242

Cane Harvester H. van Dijk. (U.K.P.) 145
Cane Maceration C McNeil. (U K A.) .. 339
Cane Mills, *see* Mills.
Candy Making Machine. R J. Savage and C. E. Schulz (U K A.) .. 241
Carbons, *see* Decolorizing Carbons.
Carbonatating and Washing in Centrifugals to refine Sugars. F Murke (U.S.P.) .. 238
Cellulose, its Conversion to Glucose. R. A. Kocher. (U.K.A.) .. 45
Centrifugals W. J. Gee (U.K A.), 97, 291, Broadbent & Sons, Ltd. (U K.A.) 242, L. Rasch, (U K A), 242; J O Drews (U.K.A), 242, L. Hall (U.K.A.), 291. E.R. Curtis (U.K.A.), 291, A. Bontemps and G. N Vis (U.K.A.), 291, 339, G Calvert (U.K.A.), 339: O Sheppard (U K A.), 339, G. H Elmore (U K.A.), 339, E. S Watson (U K.P.), 479, T. W. Barber (U.K.A.), 481; C. J. H. Penning (U.K A), 481; R. A. Sturgeon (U.K.A.) .. 481
Centrifugals, Control of their Liquid Supply. H. A. Wilson. (U K P.) .. 144
Centrifugal Covers, their Locking. G. Aitken (U.K P.) .. 478
Centrifugal for Clarifying Juices and Liquors. J Hamill. (U.K.P) .. 239
Centrifugal Spindles. A. R. Robertson. (U.K.A.) .. 339
Charcoal, Animal, Revivification. M. Weinrich (U.K A.), 45, 382; (U.S.P.), 336; R. S. Kent (U.S.P) .. 529
Chocolate Covering Machine. F. J. Michallat (U.K.A.), 97; H. G. Doelinger, (U.K P.) .. 238
Clarification and Milling System. H. S. Truscott. (U S.P.) .. 94
Clarifier containing Phosphoric Acid. Kwanto Santo Kabushiki-Kaisha and others. (U.K.A.) .. 339
Chain Belt for Mill. J. W. Hyatt. (U.K.P.) 575
Colouring Bodies for Food. A. Boake, Roberts & Co., Ltd. (U.K.A.) .. 339
Confectionery Machine. R. J. Savage and C. E. Schulz. (U.K.P.) .. 241

Decolorizing Carbon. A. Macdonald (U.K.A), 194; A. H. Bonnard and T. E. Rule (U.S.P), 241, 339; R. von Ostrejko (U.K A.), 339; Ensuiko Sugar Manufacturing Co., and others (U.K A.). 386; H. M. Shilstone (U.K.A.), 386; R. M. Catlin (U.S P.) .. 480
Decolorizing Carbon, its use in facilitating Filtration A Wijnberg. (U.S P.) . 237
Decolorizing Carbon, its use in inverting Sugar Syrup. J J., J C. N., and A G. Eastick (U K P.) .. 289
Decolorizing Carbon Revivification. A. Wijnberg (U K A), 97; (U.K.P) .. 431
Diffusion of Beet. J. Stewart (U.S P) .. 95
Digger for Beets Landrain Frères (U K P.) 290
Distillation of Alcohol. Soc E Barbet et Fils et Cie. (U K A.) .. 291, 386 578
Drying and Granulating Sugar G. M. Engel (U S P) .. 479
Drying Starch. J. J. Merrill (U.S P.) .. 578
Dredgers for Sugar. J. V. Chapman and W. Hudson. (U K.A) .. 242

Entrainment Devices for Evaporators. H. Fay (U.K A) .. 339
Evaporation by Thermo-compression. N. L. de Vautre. (U S P.) .. 531
Evaporator Baffle-plates. H Fay (U K.A.) 339
Evaporator, having variable determined Level. E. Barbet et Fils et Cie (U.K.A) 339
Evaporator with Forced Circulation. L. Naudet. (U S P.) .. 93
Evaporators. G A. Kranse (U K.A), 97, G Fletcher & Co, Ltd, and F. Coxon (U K A.), 97, F. Brearley, R Diver, and L. de Pontchalon (U K.A), 194, Chemical and Mechanical Processes Co, and J Harvey and F A Hulme (U K A), 242; A Hale and J M Simpson (U K A), 242, Kestner Evaporator & Engineering Co., Ltd., J. A. Reavell, and W G Mann (U.K.A), 242, W A E Crombie (U.K A.), 242, W L de Baufre (U K A.), 242; J B. Watson (U K.A), 242, Griscom-Russell Co (U K A), 242, W Anderson and J. Meikle (U K P.), 291, L. N. J. Elias (U K A), 291; A. Bontemps and G. N Vis (U K.A), 291, 339, E. J. Fawke and H. Griffiths (U.K.A), 291: D. Urquhart (U K.A.), 578; W. S. Herriot (N Deerr), (U K A.), 578; J L Major (U K.A.), 339; W H Taylor (U.K.A), 386; R. H. F. Findlay (U.K.A.) .. 481

Fermentation and Production of Must, Wines, etc E. Disdier. (U K.A.) .. 97
Fermentation Process. G A. Hamlyn and C. Weizmann. (U K A.) .. 97, 339
Fermentation Starch Product. P. Dreesbach (Corn Products Refining Co.). (U.S.P.) .. 194

PAGE

Fertilizer Manufacture. Molassine Co., Ltd. and J. J. A. and H. C. S. de Whalley (U.K.A.), 97; (U.K.P.), 238; G. Defries (U.K.P.), 242; C. Deguide (U.K.A.), 242; G. L. Fowler and Gladys Mumford (U.K.P.), 286: A. I. Kaplan (U.K.P.). 97, 287; J. G. Lipman (U.K.A), 291; S. Crook and F. W. Gilbertson (U.K.A), 291; Chem. Fabrik Milch and O. Rabenau (U.K.A.), 291; A. D. Furse (U K.A.), 339; General Chemical Co. (F. W. de Jahn) (U.K.P.) 386
Fertilizer Manufacture from Molasses. A. I. Kaplan. (U K.P) 97, 287
Filter Cake Compression. F. F. Briginshaw. (U.K.P.) 529
Filter-paper. A. Yeoman. (U.K.A) .. 242
Filter-presses. F. F. Briginshaw (U K.A), 291; (U K.P.) 528, 529; A. L. Genter (U.S P.), 433, 434; D. L. Kelly (U.S.P), 576; F. J. Wagner (U.S P) 337
Filtration Butters & Co. and F. L. Bosqui (U.K.A.), 97, Vickers Ltd. and others (U.K.A.), 97; Zahm Manufacturing Co. (U.K.A.), 242; P V. Yovanovitch (U.K.A.), 242; R. Harvey (U.K.A.), 242; C D. Burchenal (U K.A), 242; W. Boby (U K.A.), 242; P. L Wooster (U K.A.), 481; D. B Morison (U.K.A.) 578
Filtration: its Facilitation by the Use of Decolorizing Carbon. A. Wijnberg. (U.S P.) 237, 431
Fondant and Chocolate Covering Machine. F. J. Michallat. (U.K.A.).. 97

Glassware Lettering. J. James & Co. (U K.A).. 194
Glucose, its Continuous Manufacture from Starch. C. L. Sovereign and A. W. H. Lenders (Corn Products Refining Co.). (U S.P) 143
Glucose, its Conversion from Cellulose. R. A Kocher (U K A.) 45
Glue Substitute. V. G. Bloede (U S.P) 238
Granulating and Drying Sugar. G Engel. (U.S.P) 479
Gums and Pectins, their Removal by Decolorizing Carbon A Wijnberg. (U S P.), 237

Harvester for Beet. T. V. Jensen (U.K.P.)— 146, 242
Harvester for Cane. H N van Dijk. (U K P.) 145
Heat, its Utilization for Steam Generation. W H Panton (U K A) 45, 97
Honeys, etc, their Production E Disdier. (U K.P) . 97
Hydraulic Pressure Gear for Mills. W. Mackie (U K P.) 288
Hydrosulphite Manufacture E F. Ehrhardt. (U K.A) 291
Hydrosulphites, Sulphur Oven for their Production. L. Descamps. (U.K P.) .. 288

Incrustation Prevention Cie Gén. Détartrage, (U.K.P.), 193, 242; J. M. J. Coadie (U.K.A.) 481
Indicating Device for Mills. J. Miller and G Fletcher & Co., Ltd. (U.K.P.) .. 192
Insecticides, Colloidal. G. L. Lemmens and P. J Fryer. (U K P.) . 386
Invert Sugar Manufacture. N. W. Taussig (U S.P.), 237; (U.K.A.) 291
Invert Sugar Manufacture, using Decolorizing Carbon J. J, J. C. N., and A. G. Eastick. (U K P.) 289
Inulin and Levulose Manufacture. A. Daniel (U K.A.), 481; (U.K P.) 576

Jam Manufacture. R. J. Russell (U.K.A), 97; (U.K.P.).. 290
Jam Manufacture from Beetroot Extract. E. Chatillon and G Quarré. (U.K.A.) 481
Juice Milling and Purification System. H. S. Truscott. (U.S.P.) 94
Juice Extraction. J. H. Hyatt. (U.K.A).. 97

Lagging Casings for Boilers and Pipes. W. P. Wrightson. (U.K.A.) 194
Levulose and Inulin Manufacture. A. Daniel (U.K.A.), 481; (U.K P.) 576

Maceration of Cane. C. McNeil. (U.K.A.) 339
Manures, *see* Fertilizers.
Marmalade Manufacture. R. J Russell. (U.K A), 97; (U.K.P.) 290
Meters for Liquids. Sugar Centrifugal Discharger Co (U.K.A.) 481
Microscopic Examination of Massecuite. W. A. Baldwin. (U S.P.) 481
Mill Chain Belt. J. W. Hyatt. (U.K.P.) .. 575
Mill Hydraulic Pressure Gear. W. Mackie (U.K P.) 288
Mill Indicating Device. J Miller, and G. Fletcher & Co., Ltd (U K.P.) . .. 192
Mill Rollers with Resiliently Mounted Pins. A. M. Erkelens (U K.P.) .. 286
Mill Roller Bushes, Key for Locking. J. Miller, and G. Fletcher & Co., Ltd. (U.K.P.) 477
Mill Trash Turners. G. Fletcher & Co., Ltd., and J. Miller (U.K.A), 194, (U.K.P.) 477
Mill with Automatic Regulation of Feed and Discharge. Soc. Anon. J. J. Gilain (U.K.P) 384
Mill with Adjustable Bagasse Bridge. G. Nicolai. (U.K P.) 385
Mills. G. Fletcher & Co., Ltd, and J Miller (U.K A.), 194, 242; (U K P), 477, R. R Hind (U.K.A.), 242, Fawcett, Preston & Co, Ltd., and others (U K.A), 481, J. Wilson (U.K.A.) 578
Milling System with Straining and Purification of the Juices. H. S. Truscott. (U.S P) 94
Molasses, its Use for Fertilizer Manufacture A I Kaplan (U.K.P.), 97, (U K P) 287
Molasses Utilization for Alcohol Manufacture G A. Hughes. (U K.A.) .. 339
Moulds for Sugar, their Cooling. G. A. Widström. (U.K.A.) 481
Mucors, their Application in Alcohol Production Soc d'Exploit. Proc. H. Boulard. (U K A) 242

Non-conducting Boiler Covers W. P Wrightson. (U.K.A) 194
Nucleic Acid Manufacture from Peat W. B. Bottomley (U.K.A) . . . 97
"Nulmoline" Manufacture. N W. Taussig. (U.S.P.) 237

Object Glasses of Optical Instruments, and Prevention of Water Deposit upon them. A. Hilger, Ltd, and F. Twyman (U.K A.) 481
Oils, their Purification after Use C. J Skidmore and P F Conerty (U.K.P) 432
Oven for Sulphur Dioxide in Hydrosulphites. Louis Descamps (U.K.A). 288
Oven, Sulphur. A. G Hinzke (U S.P) 338
Oxalic Acid Manufacture from Sugar. E R von Portheim. (U.K.P) 45, 97

Packing Sugar. C. Vautin. (U.K.A.) .. 242
Pan Circulating Device A Krug (Soc Anon A. Maguin. (U S.P.) .. . 142
Pan Syrup, its Microscopic Examination. W. A Baldwin. (U.S P.) 481
Peat, its Treatment for Manurial Purposes. W B. Bottomley (U.K.A.), 97; J. J A. and H. C. S. de Whalley (U K.P.), 238; A. Nightingale (U.K.P.) 576
Peat, its Use in Sugar Manufacture. W. Baines and W. Hamilton. (U.K.A.) .. 291
Pectins and Gums, their Removal by Decolorizing Carbon. A. Wijnberg. (U.S.P.) 237
Paper Manufacture from Bagasse, etc. M. W. Marsden. (U.S.P.) 238

PAGE
Phosphatic Manures. S. Crook and F. W. Gilbertson (U.K.A.), 291; Chem. Fabrik Milch and O. Rabenau (U.K.A.), 291; General Chemical Co. (F. W. de Jahn). (U.K.A.), 386; J. S. Ledwidge and C. McKenny (U.K.A.), 386; G. A. Mower and F. W. R. Williams (U.K.A.) 481
Phosphoric Acid Clarifier. Kwanto Sanso Kabushiki-Kaisha and others. (U.K.A.) 339
Pipettes, Analytical. P. E. Spielmann. (U.K.A.) 339
Polarimeter Object Glasses A. Hilger, Ltd. and F. Twyman. (U.K.A) 481
Press, *see* Filter-Press
Purification and Milling of Juices. H. S. Truscott. (U.S P.) 94

Rectifying Apparatus. Soc. Barbet et Fils & Cie. (U.K.A.) 291, 386, 578
Refining Sugar. G A Widström. (U.K.A.) 481
Refining Sugar by Washing in Centrifugals and Carbonatating. F. Murke. (U.S P) 238
Revivification of Char. M. Weinrich (U.K.A), 45, 382; (U.S.P.), 336; R. S. Kent (U.S.P) 529
Revivification of Decolorizing Carbon. A. Wijnberg (U K A), 97; (U.K P.) 431
Roller Bushes, Key for Locking J Miller and G. Fletcher & Co., Ltd. (U.K P) 477
Roller Indicator for Mills J. Miller and G. Fletcher & Co , Ltd. (U.K P) 192
Rollers having Resiliently Mounted Pins. A. M Erkelens. (U K.P.) 286

Saccharic Acid Manufacture Diamalt-Akt -Ges (U.K.A.), 481, (U K.P.) 576
Saccharimeter Object Glasses. A. Hilger, Ltd , and F. Twyman. (U.K.A) 481
Scale Prevention or Removal. Cie. Gén. Détartrage, (U K P.), 193; (U.K A.), 242; E Makin (U.K A), 194; J. M. J. Coadie (U.K.A.) 481
Sewage Oxidation for Fertilizer Manufacture. G. L. Fowler and G. Mumford. (U K P) 286
Smoke Consumption in Boilers. G. Watson. (U K.A) 97
Solidified Alcohol. A de Swiecinski. (U K A.) 194
Spindles for Centrifugals. A. R. Robertson. (U K.A) 339
Starch Factory Waste Waters. W. N Sage. (U S P) 194
Starch Glucose Manufacture C. L. Sovereign and A. W H. Lenders (Corn Products Refining Co). (U.S.P.) 143
Starch: its Use for Manufacture of a Glue Substitute. V. G Bloede (U.S P.) 238
Starch Manufacture. A. W. H. Lenders. (U S P) 481, 481, 578
Starch Product for Use in Fermentation. P. Dreesbach (Corn Products Refining Co.). (U.S.P.) 194
Steam: its Generation from Waste Heat. W. H. Panton. (U.K.A.) 45, 97
Stirling Steam Boiler. H. G. C. Fairweather. (U.K.P.) 146
Sugar Cooling when filling into Moulds. G A Widström. (U.K.A.) 481
Sugar Drying and Granulation. G. Engel. (U S.P.) 479
Sugar Extraction from Peat. W. Baines and W. Hamilton (U.K.A.) 291
Sugar: its Conversion to Oxalic Acid. E. R. von Portheim (U K.P.), 45; (U.K.A.). 97
Sugar Manufacturing Process. O. Carr. (U.S.P.) 434
Sugar Packing C. Vautin. (U.K.A.) 242
Sulphur Oven. A G. Hinzke (U.S.P.), 338; L. J Foret (U.S.P.) 435
Sulphur Oven for Hydrosulphite Manufacture L. Descamps. (U.K P.) 288
Superphosphate Manufacture. Chem. Fabrik Milch and O. Rabenau (U.K.A.). 291; J. G Ledwidge and C. McKenny (U K.A.); 386; G. A. Mower and F. W. R. Williams (U.K A.) 481
Sweetening Material. J. H. Wrigley. (U.K A.) 291
Syrup Filler. R. Beaumont. (U.K.A.) 386
Syrups: their Production. E. Disdier. (U.K.A.) 97

Tank Measurement F H. Clift (U.K.P.), 287, Foster Engineering Co , and R. I. Bagnall (U K.A) 386
Tartaric Acid Manufacture Diamalt-Akt - Ges. (U K.A), 481, (U K.P.) 576
Thermo-compression in Evaporation. W. L de Vaufre (U S P) 531
Topping Machines for Beets. Landrain Frères and J. H. Jack. (U.K.A) 194
Trash Turners G. Fletcher & Co., Ltd., and J Miller (U K.A), 194; (U K P.) 477
Tube Scale Removal. Cie. Gén Détartrage. (U K.P.) 193, 242

Vacuum Pan Circulating Device A Krug (Soc Anon A Maguin) (U.S P) 142
Vacuum Pan Syrup, its Microscopic Examination. W A Baldwin. (U S P.) 481
Vinasse, its Use for Fertilizer Manufacture. A. I. Kaplan (U K P), 97, (U.K.P) 287

Waste Heat, its Utilization. W. H. Panton. (U K.A.) 45, 97
Waste Waters from Starch Factories, their Utilization W. N. Sage. (U.S P.) 194
Wines, Musts, Syrups, etc , their Production. E. Disdier. (U.K A.) 97

NAMES.

Aitken, G. Centrifugal Covers. (U.K.P.) 478
Anderson, W. & **Meikle**, J. Evaporator (U K.P). 291

Babcock & Wilcox Co., and **Fairweather**, H. G. C. Boiler. (U.K P.) 146
Baines, W & **Hamilton**, W. Sugar Extraction. (U K A.) 291
Bagnall, R. I. & **Foster Engineering Co.** Tank Indicator. (U.K.A.) 386
Baldwin, W. A. Microscopic Examination of Syrup (U S.P.) 481
Barber, T. W. Centrifugal. (U.K.A) 481
Barbet et Fils, **Soc. E.** Rectification Apparatus. (U.K.A.) 291, 386, 578
Barbet et Fils, **Soc. E.** Evaporator. (U.K.A) 339
Baufre, W. L. **de**. Evaporator. (U.K.A.) 242
Beaumont, R. Syrup Filler. (U.K.A.) 386
Bloede, V. G. Glue Substitute. (U.S.P.) 238
Bonnard, A. H., and **Rule**, T. E. Decolorizing Carbon. (U.K.P.) 241, 339
Bottomley, W. B. Treatment of Peat. (U K A) 97
Boby, W Cloth Filter (U K A.) 242
Bontemps, A. & **Vis**, G. N. Evaporator. (U K.A) 291, 339
Boake Roberts & Co., Ltd Colouring Bodies (U K A.) 339
Bosqui, F. L , and **Butters & Co.** Filter (U.K.A) 97
Boulard, **Soc. d'Exploit. Proc.** Alcohol Manufacture. (U.K.A.) 242
Brown T. E. Clarifying Centrifugal. (U.K P.) 241
Brearley, F., **Diver**, R., and **Pontchaion**, L **de**. Evaporator. (U.K.A) 194
Briginshaw, F. F. Filter Presses. (U.K.A.) 291
Briginshaw, F. F. Vertical Filter. (U.K.A.) 528
Briginshaw, F. F. Compressing Filter Cakes. (U.K P.) 529
Broadbent, T. & **Sons, Ltd.** Centrifugal. (U.K.A.) 242, (U.K.P.) 576
Burchenal, C. D. Filters. (U.K.A.) 243
Butters & Co., and **Bosqui**, F. L. Filter: (U.K.A.) 97

Patents.

PAGE
Calvert, G. Centrifugal. (U.K.A.) 339
Carr, O. Sugar Manufacture. (U.S.P.) .. 434
Catlin, R. M. Decolorizing Material. (U.S.P.) 480
Chapman, J. V., and Hudson, W. Sugar Dredgers. (U.K.A.) 242
Chatillon, C., and Quarré, G. Beetroot Extract and Jam Manufacture. (U K.A.) 481
Chemical and Mechanical Processes Co., Harvey, J., and Hulme, F. A. Evaporator. (U.K.A.) 242
Chemische Fabrik Milch Akt -Ges and Rabenau, O Superphosphates. (U.K.A.) 291
Circulators Ltd. Boilers. (U.K.A.) . 97
Clark, G. M (Landrain Bros.). Beet Digger. (U.K.P.) 290
Clear, J. P., Vickers Ltd. and J. McKechnie. Filter. (U.K.A.) . . 97
Clift, F. H. Tank Measurement (U.K P) 287
Coadie, J. M. J. Incrustation Removal. (U.K.A.) 481
Compagnie Générale de Détartrage. Boiler Scale Removal. (U.K.P) .. 193, (U.K.A.). 242
Conerty, P F., and Skidmore, C. J. Purifying Used Oil. (U.K P.) 432
Corn Products Refining Co., and Dreesbach, P Starch Product. (U S P) 194
Corn Products Refining Co., Sovereign, C. L., and Lenders, A. W. H. Manufacture of Glucose. (U.S.P) . 143
Coxon, F, and Fletcher & Co. Ltd Evaporator (U.K A) 97
Crombie, W. A E Evaporator. (U K.A.) 242
Crook, S., and Gilbertson, F W Phosphatic Manure (U.K A.) . . 291
Curtis, E R. Centrifugal. (U K A.) . .. 291

Daniel, A Production of Inulin and Levulose (U K A) 481. (U.K P) . .. 576
Davies, J P. Boilers (U K.A).. .. 97
Deerr, N , and Herriot, W. S. Evaporator. (U K.A) 578
Defries, G. Guano (U K P) 242
Deguide, C Fertilizer (U.K.A) .. 242
Descamps, L Sulphur Oven (U K P) . 288
Diamalt-Akt.-Ges Saccharic and Tartaric Acid Manufacture (U K A.) 481 (U K P.) 576
Dijk, H N. van Cane Harvester (U.K P.) 145
Diver, R., Brearley, F , and Pontchalon, L. de Evaporator. (U K A) ... 191
Disdier, E Obtaining Musts, Wines, etc (U K A.) 97
Doelinger, H G Confection Coating Machine (U K.P) . .. 238
Dreesbach, P. (Corn Products Refining Co.) Starch Products (U S.P.) . 194
Drews, J O. Centrifugals (U K A) . . 242
Dreyfus, H Alcohol Manufacture (U K A.) 481

Eastick, J. J , J C N., and A G. Invert Sugar Manufacture (U.K P) 289
Ehrhardt, E F and H W. Hydrosulphite Manufacture (U K A) 291
Elias, L N. J. Concentration Apparatus. (U.K A).. 291
Elmore, G. H. Centrifugal (U K A.) 339
Ensuiko Sugar Manufacturing and Development Co, Miyake, H. and Okadu, Y Decolorizing Carbon (U K.A.) 386
Engel, G Drying Sugar (U S P.) 479
Erkelens, A M. Mill Rollers. (U K P) . 286

Fairweather, H. G. C. (Babcock & Wilcox Co) Boiler. (U.K.P.). 146
Fawcett, Preston & Co., Ltd., Taylor, H. W., and Lang, A. M. Cane Mills. (U.K.A) 481
Fawke, E J., and Griffiths, H. Evaporator (U.K.A.) 291
Fay, H. Evaporator Baffle Plates (U.K A) 339
Findlay, R. H. F. Evaporator. (U K A.) 481
Fletcher & Co., Ltd., and Coxon, F. Evaporator. (U.K A.) 97
Fletcher & Co, Ltd, and Miller, J. Indicator for Mills. (U.K.P.) 192

PAGE
Fletcher & Co., Ltd, and Miller J. Cane Mills. (U.K.P.) 194, 242, 477
Foret, L. J. Sulphur Box (U S.P.) 435
Foster Engineering Co, and Bagnall, R. I. Tank Indicator. (U.K.A) .. . 386
Furse, A. D. Manure Manufacture. (U.K A) 339

Gee, W. J. Centrifugal. (U.K.A.) .. 97, 291 (U.K.P.) 386
General Chemical Co. (F. W. de Jahn).
Genter, A Filter-press. (U S.P.) .. 433, 434
Gilain, Soc. Anon. de J. J. Mill (U.K.P.) 384
Gilbertson, F. W., and Crook, S. Phosphatic Manure. (U.K.A.) 291
Griffiths, H., and Fawke, E. J. Evaporator (U.K A) 291
Griscom-Russell Co. Evaporator (U.K A.) 242

Hale, A., and Simpson, J. M. Evaporator. (U K A) 212
Hall, L Centrifugal (U K A) . 291
Hamill, J. Clarifying Centrifugal (U.K P.) 239
Hamilton, W, and Barnes, W. Sugar Extraction. (U.K.A.) . 291
Hamlyn, G. A, and Weizmann, C. Fermentation Process (U K.A). 97, 339
Harvey, J., Hulme, F A, and Chemical & Mechanical Processes Co. Evaporator (U K A.) 242
Harvey, R Purifying Juices and Syrups. (U.K A) 242
Herriot, W S. (N Deerr) Evaporator. (U K A) 578
Hind, R. R Mill Housings. (U K A.) .. 242
Hilger, A., Ltd., and Twyman, F Prevention of Water Deposition upon Object Glasses. (U K A.) 481
Hinzke, A G. Sulphur Oven (U.S.P) 338
Hudson, W, and Chapman, J V. Sugar Dredgers. (U K.A) . . 242
Hughes, G. H Manufacture of Alcohol from Molasses. (U.K A) . .. 339
Hulme, F A., Harvey, J, and Chemical and Mechanical Processes Co Evaporator (U K A.) . .. 242
Hyatt, J W Juice Extraction (U K A). 97
Hyatt, J W. Belt for Mill. (U K P) . .. 575

Jahn, F W de, and General Chemical Co Phosphatic Manure (U K P) 386
James, J, & Co Lettering Glassware. (U.K A) . . . 194
Jensen, T V Beet Harvester. (U K A) 146, 242

Kaplan, A. I Fertilizer Manufacture from Molasses (U K P) . . 97, 287
Kelly, D J. Filter-press (U S P) . 576
Kestner Evaporator & Engineering Co, Ltd, Reavell, J. A, and Mann, W G Evaporator, (U K A) . . 242
Kent, R S Revivification of Animal Charcoal (U S P) 529
Kocher, R A Conversion of Cellulose to Glucose (U K.A) .. 45
Krause, G. A. Evaporator (U.K A) . 97
Krug, A (Soc. Anon. Etabl. A. Maguin.) Circulator for Pans (U S P.) . . 142
Kwanto Santo Kabushiki-Kaisha, Emura, U, and Hayashi, T Phosphoric and Clarifier. (U K A) 339

Landrain, Frères, and Jack, J. H. Beet Topping Machines. (U.K A) 194
Landrain, Frères and Clark, G. M. Beet Digger. (U K P) . . . 290
Lavedan, L. Alcohol Manufacture. (U K.P) 96
Lemmens, G. L., and Fryer, P J. Insecticide (U.K.P) 386
Lenders, A. W. H., and Sovereign, C. L. (Corn Products Refining Co.) (U S P.) 143
Lenders, A. W. H. Starch (U S P). 481, 578
Ledwidge J. G., and McKenny, C. Superphosphate Manufacture. (U K.A) .. 389
Levin, B. Phosphate Manufacture (U.K.A.) 242
Lipman, J. G. Fertilizer. (U K A) . .. 291
Lund, H. J Cleaning Boilers (U K A) . 45

Index.

PAGE

M

Macdonald, A. Decolorizing Carbon. (U.K.A.) .. 194
Mackie, W. Hydraulic Mill Gear. (U.K.P.) 288
Maguin, Soc. Anon. Etabl., and Krug, A. (U.S.P.) .. 142
Major, J. L. Evaporator. (U.K.A.) .. 339
Makin, E. Water Purification. (U.K.A.) . 194
Mann, W. G., Reavell, J. A., and Kestner Evaporator & Engineering Co., Ltd. Evaporator. (U.K.A.) .. 242
Marks, E. C. R., and Sugar Centrifugal Discharger Co. (U.K.A.) .. 481
Marsden, M. W. Paper Manufacture from Bagasse. (U.S.P.) .. 238
McKechnie, J, Vickers, Ltd., and Clear, J. P. Filter. (U K.A.) .. 97
McKenny, C, and Ledwidge, J, G. Superphosphate Manufacture. (U.K.A) .. 386
McNeil, C. Cane Maceration. (U.K.A.) .. 339
Meikle, J., and Anderson, W. Evaporator. (U.K.P.) .. 291
Merrill, J. J. Drying Starch. (U S P) .. 578
Michallat, F. J. Chocolate and Fondant Machine. (U K.A.) .. 97
Milch Chemische Fabrik and Rabenau, O. Superphosphate. (U.K.A) .. 291
Miller, J., and Fletcher & Co., Ltd. Cane Mills. (U.K A) .. 194, 242
Miller, J., and Fletcher & Co, Ltd Cane Mill (U K P) . 477
Miller, J., and Fletcher & Co., Ltd. Indicator for Mills (U.K P.) 192
Miyake, H., Ensuiko Sugar Manufacturing and Development Co, and Okadu, Y. Decolorizing Carbon. (U K A) .. 386
Molassine Co., Ltd., and de Whalley, J. J. A., and H C. S (U K A) .. 97
Moore, C G Starch Manufacture (U S.P.) 481
Morison, D B Filter. (U K A) . 578
Morison, D. B. Heating Feed Water (U.K A) .. 194
Mower, G. A., and Williams, F. W R. Superphosphate Manufacture. (U.K A.) 481
Murke, F. Refining Raw Sugar (U S P.). 238

N

Naudet, L. Evaporator (U S P.) .. 93
Nicolai. G. Cane Mill (U K P) .. 385
Nightingale, A Peat Fertilizer (U.K.P.) 576
Norit White Sugar Co. and Wijnberg, A. Decolorizing Carbon (U.K.A.), 97, (U.S.P.) .. 237

O

Okadu, G., Miyake, H, and Ensuiko Sugar Manufacturing and Development Co. Decolorizing Carbon (U.K.A) 386
Ostrejko, R. von. Decolorizing Carbon (U.K.A.) .. 339

P

Panton, W H. Utilization of Waste Heat. (U K A) .. 45, 97
Penning, C. J. H Centrifugal (U.K A) 481
Pontchalon, L. de, Brearley, F., and Diver, R. Evaporator. (U.K A.) .. 194
Portheim, E. R. von. Oxalic Acid Manufacture (U K P.), 45, (U.K.A.) .. 97

Q

Quarré, G., and Chatillon, C. Beetroot Extract and Jam Manufacture. (U.K.A.) 481

R

Rasch, L. Centrifugal. (U.K.A.) .. 242
Reavell, J. A., Kestner Evaporator & Engineering Co. Ltd, and Mann, W. G. Evaporator. (U.K.A.) .. 242
Robertson, A. R. Centrifugal Spindles. (U.K.A.) .. 339
Rule, T. E., and Bonnard, A. H. Decolorizing Carbon. (U.K.P.) .. 241, 339
Russell, R. J. Marmalade Manufacture (U.K.A.), 97; (U.K.P.) .. 290

S

Sage, W. N. Starch Waste Waters. (U.S.P.) .. 194
Savage, R. J., and Schultz, C. E. Candy Machine. (U.K.P.) .. 241
Schultz, C. E., and Savage, R. J. Candy Machine (U.K P.) .. 241
Scott, D. T. Boilers. (U.K.A.) .. 242
Sheppard, O. Centrifugal. (U.K.A.) .. 339
Shilstone, H. M. Decolorizing Carbon Manufacture. (U.K.A.) .. 386
Simpson, J. M., and Hale, A. Evaporator. (U K A) .. 242
Skidmore, C. J., and Conerty, P. F. Purifying Used Oils. (U.K.P.) .. 432
Sovereign, C. L., and Lenders, A. W. H. (Corn Products Refining Co.) Manufacture of Glucose. (U S P.) .. 143
Spielmann, P F Pipettes. (U.K.A.) .. 339
Stewart, J. Beet Diffusion. (U.S.P.) .. 95
Stoneman, A. J. Ignition of Alcohol. (U.K.A.) .. 481
Sturgeon, R. A. Centrifugal. (U.K.A.) . 481
Sugar Centrifugal Discharger Co. (E. C R. Marks.) Liquid Meters. (U.K.A.) 481
Swiecinski, A. de Solidified Spirit. (U.K.A.) .. 194

T

Taussig, N W Invert Sugar Manufacture. (U.S P.) 237 (U K A) .. 291
Taylor, W H. Heating or Concentrating Solutions. (U.K.A) .. 386
Thompson, W. P Fertilizer Manufacture from Molasses. (U.K.P.) .. 97, 287
Truscott, H. S. Juice Milling, and Purification (U S.P.) .. 94
Twyman, F, and Hilger, Ltd. Prevention of Water Deposition upon Cover Glasses. (U K A) .. 481

U

Urquhart, D. Evaporator and Still. (U K A.) .. 578

V

Vaufre, W. L. de. Evaporation by Thermocompression. (U.S.P) .. 531
Vautin, C Packing Sugar (U K A.) . 242
Vickers, Ltd, Clear, J. P., and McKechnil, J. Filter (U K A.) .. 97
Vis, G. N., and Bontemps, A. Evaporator (U.K.A) .. 291

W

Wagner, F J. Continuous Filter-press. (U S.P.) .. 337
Watson, J. B Evaporator (U.K.A.) .. 242
Watson, C S Centrifugal (U.K.P.) .. 479
Watson, G. Boilers (U K A) .. 97
Weinrich, M Revivification of Char. (U K A) 45, (U.S P.) .. 336, 382
Weizmann, C. Fermentation Process. (U.K.A.) .. 97, 339
Whalley, J. J. A., and H C. S. de, and Molassine, Ltd. (U.K.A.) .. 97
Whalley, J. J. A, and H C. S. de. Peat Fertilizer. (U.K.P.) .. 238
White, G. Decorating Confectionery. (U.K A) .. 97
Widström, G. A. Cooling Sugar while Filling into Moulds. (U.K A.) .. 481
Wijnberg, A. (Norit White Sugar Co.). Decolorizing Carbon (U K.A.), 97; (U S P), 237; (U.K.P.) .. 431
Williams, F W. R., and Mower, G. A. Superphosphate Manufacture (U.K.A.) 481
Wilson, H. A Centrifugal. (U.K.P.) .. 144
Wilson, J. Cane Mill. (U.K.A.) .. 578
Wooster, P. L. Cleaning Filters. (U.K.A.) 481
Wrightson, W. P. Coverings for Boilers. (U.K A.) .. 194
Wrigley, J. H. Sweetening Material. (U.K.A.) .. 291

Y

Yeoman, A. Filter-paper. (U.K.A.) .. 242
Yovanovitch, P. V. Filter. (U.K.A.) .. 242

Z

Zahm Manufacturing Co. Filter. (U K.A.) .. 242

THE

INTERNATIONAL SUGAR JOURNAL.

No. 217. JANUARY, 1917. Vol. XIX.

☞ All communications to be addressed to "The International Sugar Journal," 2, St. Dunstan's Hill, London, E.C.

Cheques and Postal Orders to be made payable to "The INTERNATIONAL SUGAR JOURNAL," and not to individuals.

☞ The Editors are not responsible for statements or opinions contained in articles which are signed, or the source of which is named.

The Editors will be glad to consider any MSS. sent to them for insertion in this Journal and will endeavour to return the same if unsuitable; but they cannot undertake to be responsible for them unless a stamped addressed envelope is enclosed.

Notes and Comments.

The Control of the Food Supplies.

Lord Devonport's appointment as Food Controller has promptly given signs of promising developments; and just as we go to press comes the news of six new Food Orders which have been issued. One of these relates to sugar: it limits the price at which chocolate confections and sweetmeats may be sold to 3d. per oz. for the former and 2d. for the latter; it prohibits the use of sugar or chocolate for the external covering of cakes, pastry, or similar articles; and finally it restricts the amount of sugar that may be used for confectionery in general, whether for extravagant sweets or other sweets, to 50 per cent. of the amount used during 1915, which it is understood was about the same as that in 1914. On the other hand, there is no intention to interfere with the distribution of sugar used for the making of jam or marmalade. The Food Controller hopes to be in a position when the fruit season comes on again to make a liberal distribution of sugar for this purpose.

So far so good; these restrictions on sugared goods are along lines which we have all along ventured to indicate were desirable. The next step, we take it, will be to regulate the price of sugar itself (as well as certain other foods) to the consumer. For the present it is known that not only sugar but grain and potatoes are to be supplied to the public through Government agency. The farmers are to be paid certain prices for their crops and the public will doubtless benefit by a more or less fixed price for the retailed article. But as the supply is necessarily somewhat limited, while the earning power of the populace (at all events in its more numerous elements, the so-called working classes) has increased appreciably of late, it seems a foregone conclusion that some form of rationing must be instituted. Only this will prevent the more prosperous section of the community from hoarding in excess at the expense of their less fortunate brethren. It will also put a stop to the present unfair discrimination practised by retailers in demanding orders for other food as a condition of sugar being sold—orders which in some cases have run as high as 5s. worth of goods per lb. of sugar, and have naturally worked to the disadvantage of the poor. It may be added that whatever measures are decided on in order to regulate the sugar consumption they will be more readily workable in that the Royal Commission on Sugar Supply is being put, as we understand, under **Lord Devonport**'s presidency.

With the dawn of a new year, there is a widespread feeling of hopefulness as to the early termination of the war. But it is not, on the side of the Allies, due to any slackening in resolve to achieve the objects they have set out to gain. Their resolution is unimpaired, and their plans are being drawn up on a scale that does not reckon on any early cessation of hostilities. But in spite of this, indications are not wanting that the enemy has passed the zenith of his success, and his decline and downfall may be accelerated by a variety of causes. But the hope that this will prove to be so must not allow any slackening in the effort to bring it about; and those who have the say in the matter are fortunately convinced that nothing should be left to chance. Hence the expedition with which sundry measures are being introduced to easen the stringency of war-time existence. Such measures, if wisely conceived, must prove of incalculable benefit for all future, and the country will not regret the fiery trial through which it has passed if the gain is commensurate.

A New Era for Agriculture in the United Kingdom.

The submarine war on British and neutral shipping, to which the Germans have directed all their efforts of late, has met with a sufficient degree of success to force the authorities at home to resort to revolutionary measures in dealing with the food supply. But whatever the menace should involve for us during the war itself, it promises in its larger results to prove something of a blessing in disguise, inasmuch as it has precipitated measures for the revival of British agriculture; and we may shortly see a very considerable expansion in the home-grown proportion of the food supply which the United Kingdom annually requires. Once the expansion is a fact, it is hardly likely that the increase will be allowed to suffer any appreciable decline in *post bellum* days The country will have had too close an escape from real food shortage to readily forget the lesson.

The plans of the Board of Agriculture, under its new President, Mr. **Prothero**, who is a practical agriculturist, are not yet complete; but it is already clear that among the measures to be taken are the regulation of the labour supply, the guarantee of a fair price for some years for certain crops, the adequate provision of manures, and, what is perhaps most interesting, the organization of a system of labour-saving agricultural machinery for cultivating the fields. Such machinery will doubtless be loaned by arrangement to needy farmers to enable them to get their fields tilled and the subsequent crops reaped; and it should prove not only a valuable experiment in the way of co-operative cultivation, but should also demonstrate the advantages of labour-saving appliances and teach the farmers a useful lesson. While there are of course many exceptions to the rule, the fact remains that the British farmer is a naturally conservative person and is not naturally disposed to undertake any radical experiments. To do him justice, however, he has till now never had the encouragement of State aid to further him in any research he might have been inclined to make; and, as has been pointed out,[1] he could hardly in consequence be expected himself to sink money in experiments which might not bring in any practical return. Sugar beet culture supplies an illustration of this point. But now that the State is obliged for national reasons to control the country's agriculture it must see to it that what improvement is made is lasting.

Nothing has been said lately as to the immediate prospects of the British beet sugar industry. Lack of seed spoilt any chance Cantley had last year of making a profitable crop. But even were the seed forthcoming for 1917 the fact has to be faced that we have only one sugar factory in existence, and it is hardly likely that the Government will care to hustle the construction of any additional ones for next autumn's crop. Wonderful stories could no doubt be told of the speed with which new factories for making war material have been erected on almost "virgin soil" in this country; but it is not likely that the same policy would be adopted as regards sugar factories, nor can in our opinion any such step be recommended, inasmuch as it is very important that when the next sugar factory in this country is planned it should be designed on the most approved lines (which Cantley with its Steffen process most certainly was not) so as to minimize the risks from various more or less preventible forms of failure and present a chance for a real test of our ability to produce sugar profitably. For these reasons time should be allowed for a well-thought-out scheme But there is no reason why 1918 should not see its inauguration on an appreciable scale. Till then, all surplus land and agricultural labour will probably be devoted to the production of the more familiar grain and root crops.

---

[1] *I.S.J.*, 1916, 354.

The prospects of sugar beet cultivation receiving in the end adequate attention are certainly enhanced by the fact that Mr. T. H. MIDDLETON, C.B., Assistant Secretary to the Board of Agriculture, has been appointed head of the new Food Production Department which has been organized within the Board of Agriculture. A few months ago we had occasion to reproduce in our pages[1] this gentleman's succinct survey of the advantages to German agriculture of sugar beet cultivation and we are sure that given the chance he will not be slow to apply the same principles to agriculture in this country also. We therefore look forward to some pleasing developments in the near future, though any immediate action seems precluded owing to the more pressing demands on home farmers for the supply of grain and potatoes. But the experience that is sure to be gained in the revival and organization of our agriculture will later on much facilitate the successful introduction of new crops and crop rotations.

Soil Aëration in Agriculture.

Mr. A. HOWARD, C.I.E., the Imperial Economic Botanist at Pusa, India, in the course of a lecture delivered last February to the Board of Agriculture at Pusa, emphasized the importance to Indian agriculture of soil aëration. Want of aëration in the soil is in India the great bar to progress in the improvement of crop varieties, and until this is removed comparatively little can be accomplished. As it happens, alluvial soils such as are found in the valleys of the Ganges and the Indus do not lend themselves readily to soil ventilation, inasmuch as, being composed of fine particles, they pack very readily and always run together on the surface after the usual tropical rains to which they are exposed in the monsoon period; the result is a well-defined surface crust which subsequently effectively impedes aëration. Now defective aëration, besides interfering with the respiration of the active cells of plant roots and of the soil bacteria, exercises a profound influence on the development of the root system of plants; crops are found to develop only superficial roots and are then particularly liable to the harmful effects of drought, for all high yielding and drought-resisting varieties are deep-rooted. Thus, any appreciable interference with the supply of air to roots must lead to a wilted poverty-stricken condition of the crops and to a diminished yield.

The remedies Mr. HOWARD advocates include the more thorough drainage of the land after rains, not only locally by means of field trenches, but also by providing a better outflow for the tributary streams, which too frequently are blocked by continuous embankments with an insufficient number of culverts.

---

[1] *I.S.J.*, 1916, 354.

An extension of green manuring is also strongly advocated, but its most successful application is found in conjunction with a system of introducing into the soil a leavening of tile fragments or stones to assist in breaking up the caking of the finer particles of soil. When such tile fragments, or *thikra* as they are called in India, are added to the soil to the extent of about 50 tons to the acre, exceedingly striking results are produced and the crops are greatly increased. On the other hand, green manure when put into imperfectly aërated and badly drained land can only have a harmful effect.

Touching on the effect of soil aeration on particular crops, Mr. Howard said that, as regards sugar cane, "the Dutch planters of Java have learnt by long experience, in growing cane on heavy soils, that there exists a close connexion between the yield of sugar and soil aeration and that the destruction of the porosity of the soil does great harm to the crop. The attention paid to the aëration of the soil in Java is one of the factors on which the development of the sugar industry in that island depends. The circumstances of the island are such that a large supply of rice has to be grown to feed the people. Rice and sugar cane often have to be grown alternately on the same land. It has been found that the only way to grow sugar cane on such land is to pay great attention to drainage and to aëration. If this is neglected, the cane suffers. One of the best methods of meeting the present competition of Java sugar in India is to improve our soil aëration just as the Dutch have done. This will increase the yield and quality of the juice and augment the outturn. Nowhere is better aëration for sugar cane so necessary as in Bihar. We shall not derive the full benefit from new seedling canes unless we pay great attention to aëration in the sugar tracts of Northern India."

Argentina.

Private advices from Argentina report that very trying climatic conditions have been prevailing there of late in the Tucumán district. The winter was a terrible one and a record breaker for frosts following on severe drought; and when the worst of the winter was over there was still a continuance of the drought, no rain having in fact fallen for seven months. Some of the new plantations are as a consequence suffering considerably, particularly from the borer (*Diatraea saccharalis*) and much ratoon cane has been hopelessly lost. The drought has been very general, and Argentina's grain crop, the country's principal resource, is almost a total failure, in consequence of which it is probable that the Government will have to prohibit exportation. Incidentally, the Argentine Government has just issued a decree which permits of the importation of 75,000 tons of sugar, 55,000 tons of which will be refined. This will surpass the calculated needs of the country by 50,000 tons, and is likely to affect prices seriously. In any event, it is bound to hamper for the present the endeavours of men like Mr. A. H. Rosenfeld to carry out much needed reforms and extensions in the native sugar industry; and this is a point which is greatly to be regretted.

The Influence of Weather on the Crops.

This, we might add, is only one of the many instances which emphasize the necessity entailed on a country like the United Kingdom (where sugar is a wholly imported commodity) of ensuring that its sugar supply be drawn from a sufficiently varied number of sources as to eliminate the consequences of one or more of these sources failing owing to adverse weather conditions. The marked influence which the failure through this cause of the Continental beet crops had in bygone days on sugar prices (when we were so dependent on this given source of sugar supply) has been again and again portrayed in our pages; yet there have been numerous advocates of the cheap sugar school who have persistently failed to see its significance. Even since the war broke out and we have paid the penalty for previous shortsightedness, there has been a tendency on the part of this same school of thought to assume that when beet fails us there are always Cuba and Java to come to the rescue. It only needs, however, a considerable failure of the crops of one or other of these islands to bring along a very considerable shortage of the world's sugar supply; and it is not beyond the bounds of possibility that Cuba's output may some season suffer a serious diminution, either owing to drought or through the outbreak of some serious disease of canes or cattle. It is therefore incumbent on the United Kingdom to do what it can within the next decade to extend the production of cane sugar in the various tropical and semi-tropical possessions of the British Empire, and not to leave the supply to be provided in the aggregate by a few neutral countries and their colonies.

British Sugar Policy and American Opinion.

The endeavours of British sugar interests to increase the supply of sugar grown within the Empire, including the inauguration of a beet sugar industry at home, are being watched with considerable interest *and sympathy* in American sugar-producing circles. The latter have learnt by experience the marked benefits accruing to such an industry as sugar growing by reasonable measures of protection, and they have long thought the *laisser faire* policy of past British Governments a perfectly incomprehensible thing. Their sympathies naturally go out towards British colonial cane planters who for years have had to struggle under a selfish free trade *régime*, and they are largehearted enough to wish that the benefits that they themselves have reaped should not be altogether denied their British colonial neighbours. Americans realize with justice that in the sugar industry there is scope for more than one area of production, and they deem that it ought to be possible for Great Britain to have her own supplies of sugar without the American crop becoming a glut on the market. Americans, in short, believe that the domestic and colonial sugar production of the United States can be profitably absorbed by their own or adjacent populations, and they are content to carry on their industry on the assumption that there is room for all.

If evidence were wanted, it is surely to be found in the following remarks in a letter received just recently from a distinguished American sugar expert who has had much to do with the organization of sugar production in the United States. "I make no rules," he writes, "for my own country which I am not able to endorse for other countries. I believe that the producers in each country should be so protected that they can, in so far as they are able, control their domestic markets and shut out the rest of the world except for commodities which they are not fitted to produce. Then let everybody fight for international trade as best they can. Of course the fittest will survive in this, but that will not ruin such countries as cannot compete with the world. Their home trade will support them. In other words, limit the gamble to international trade. Make that the unnecessary pie and cake, but conserve the home trade for, and let it be, the necessary bread and meat of the home producers. Where England's scheme has been wrong is that she has made a gamble of both the home and foreign trade, while other nations protected their domestic markets. I hope that now free trade in the world is dead. It did us some good that you were free traders, but we can afford to forego that benefit, if it will make your people prosperous, as I am sure it will." This view of an observant American student of economics is very welcome to those of us who have for years fought for the more adequate recognition of British trade and production, and we are very glad to publish such a testimony.

British *versus* American Sugar Machinery.

A disputed American Consular Report.

Considerable indignation appears to have been aroused in interested American circles by an official Report prepared by a United States Special Agent, Mr. GIRAUD HARRIS, on "Cane Mill Equipment for the West Indies," which was printed in Government Report No. 239, issued last October, and commented adversely on the quality of certain American sugar machinery as compared with some of British production which he considered the standard. This report is given below; it is not the first time that American Consular agents have ventured to criticize these productions of their country in terms which have not been exactly palatable to those concerned; but it would almost appear that in this instance he has drawn his conclusions more from particular local instances that have come to his notice than from any general survey of the whole area of the West Indies where sugar machinery exists in operation. Certainly it is not the experience of those who have visited the sugar making establishments in that part of the world that any mills worth mentioning are left "exposed to torrential rain and tropical sunlight from one season to another," and makers of modern American machinery might indeed be pardoned for not allowing a sufficient margin of strength to stand such uncommon treatment.

The Report to which exception is taken by the American makers is as follows[1]:—

"American mills are not regarded with the same favour accorded those of English make. It is complained that the American mills do not 'stand up under the work' as do the British machines. Most of the owners use equipment very roughly, leaving it exposed to torrential rain and tropical sunlight from one season to another. As a rule, the cane mill operatives, through ignorance, do everything that ought not to be done, from overfeeding the rollers (by jamming in too many stalks at once) to all other conceivable and inconceivable ways of abusing machinery and exercising lack of judgment or care.

"Only apparatus of the utmost solidity and simplicity can stand such treatment and remain efficient. This the cane mills made by a firm in Derby, England, are claimed to do. This make of mill appears to be generally the standard of excellence in the West Indies and it is preferred to any other. Various makes of cane mills have been tried, but the conclusion regarding the Derby mills remains. Nor is this preference confined to the West Indies. In several countries of Central America I have heard these same mills alluded to as being the best to be had in wearing qualities and general serviceability.

"Some mills of American make are undoubtedly being sold in the West Indies now, but the main argument for their sale is the difficulty of procuring the English mills. As between the two makes of cane mills, ordinarily, there would be no argument. The buyer would take the English mill. If he has used it before, he found it satisfactory and durable; if he is making his first venture in the use of a cane mill, he has heard of it from his neighbours. The West Indian is a conservative and prefers to follow the beaten path in the expenditure of his money."

A member of the firm of the Fulton Ironworks, who are probably the largest makers of sugar machinery in the States, takes up the cudgels on behalf of his confrères in the following comments:—

"This is a fine statement to appear in an American official document. Mr. HARRIS makes the broad statement that English mills are standard throughout the

---

[1] For this and the quotations that follow, we are indebted to our New York contemporary, *Facts about Sugar.*

West Indies, and rushes into print to repeat a statement used by our foreign competitors to the effect that American mills do not 'stand up under the work as do the British.' We believe that this kind of report made by our special representatives is an absolute detriment to the efforts of American manufacturers. Even if our competitors and some of the foreigners resident in these islands make these statements, we do not believe it is proper to have them appear in official Department of Commerce documents.

"We repudiate this statement most emphatically and are able to prove our repudiation. What success then do you suppose we would have in trying to sell a sugar mill to a prospective purchaser in the West Indies, Central, or South America if he should flash on us a copy of the official document issued by the Department of Commerce at Washington which states that a certain make of English mills is the standard of excellence in the West Indies and is preferred to any other?

"Also 'As between the two makes of cane mills, ordinarily there would be no argument.' This is a statement which is not founded on facts. There is always an argument when it comes to the sale of machinery, and we can get the best of the argument every time if the question of quality is considered. They do build cheap machinery in Europe and they build cheap machinery in the United States, but if the purchaser is looking for value commensurate with his investment he can buy just as good, if not better, machinery in the United States than he can in any country of Europe. There may be a racial prejudice against the American machinery, but this does not prevent the American manufacturer from putting up a stiff argument as to the value of his product.

"Mr. HARRIS says plainly that the only reason we can sell American mills in the West Indies at the present time is because they cannot procure English mills. This is fine advertising matter for one of their representatives to circulate. We have sold mills in the West Indies in active competition with all European manufacturers long before the war and will continue to do so long after the war. We have actually sold American mills for cash when foreign manufacturers have offered their mills on time payments extending over four years. We will make the broad statement that the American mill is the best mill manufactured in the world to-day.

"We are not looking for advertising for our own mills—we do not need it—but the fact that on many cane plantations in the West Indies we are taking out mills of European manufacture and replacing them with mills made in St. Louis, Mo., U.S.A., is sufficient proof that the quality of American machinery is such that we need make no apologies for it.

"Instead of boosting American made goods and endeavouring to show that they are better than everything else, our special representatives, along with a number of magazine writers, take special delight in printing the alleged fact that American manufacturers do not know how to handle export business and that if they do get the business they do not furnish machinery which will stand up under the duty for which it is purchased.

"We have had occasion previously to this time to take exception to reports sent in by representatives of this government. We have been actively interested in assisting the promotion of associations for the extension of American trade in the West Indies, Central and South America, and we are rapidly coming to the opinion that this work could be better accomplished if these special agents were kept out of these countries, or, at least, if some care is exercised in editing their reports before they are published."

This is certainly a vigorous protest; and coming from a member of a firm who have long turned out machinery of good repute, it is probably justified where the best American sugar machinery is concerned. But, as likely as not, the complaint made by Mr. Harris does not refer to plant of modern construction, but to that which has seen a decade or more of service; and if this is so, then there are other critics too who would claim that, comparing only those mills which have seen at least ten years' work, the average American mill has left something to be desired as compared with the average British production.

We think it is the case that where the best types of multiple crushing installations of comparatively modern construction are concerned, the excellence is in either instance of a sufficiently high and close order to make comparisons between British and American machinery a matter of individual taste and opinion, and while one party will have its own evidence in the matter of superiority, the other side will not by any means lack reassuring reports to the contrary. So the purchaser must make his final decision on the score of other factors, of which "period of delivery" is generally a very important one, and one moreover which, since the revival in sugar prices and the corresponding activity to extend or replace existing sugar machinery, has gone by chance entirely in favour of the American makers. Had Great Britain kept out of the war and maintained her commercial activity, there is no doubt that a different tale would now be told as to the derivation of the machinery which for some months past has been pouring into the sugar areas of the Caribbean Sea; the American makers would not by any means have had it all their own way. This temporary advantage to one side affects the situation so materially that no fair comparison can really be drawn at the moment from the way orders are placed; and we shall probably have to wait till the war is well over ere this drawback is eliminated.

It has always been a tendency of American machinery construction to favour a type of production which is cheap and light rather than durable; it is argued in support of the custom that by this means it is easier to scrap an out-of-date design and replace it by an improved unit which will combine the results of more recent experience. British machinery on the other hand has in the past had an unrivalled record for durability and longevity. Typical instances of the two kinds may be cited in locomotives and motor cars. American locomotives have not as a rule been built to last, while in England scores of locomotives are still to be seen running, bearing dates of the eighties of last century. Then as regards motor cars, America has made a speciality of the cheap runabout which has not as a rule been noted for a lengthy life, and when run in comparison with British products in this country has almost invariably proved more expensive to maintain even though the first cost was much lower. That there are certain makes of American cars which are not only expensive to buy but are of as high class construction as the average good class British model, is much less generally known this side of the Atlantic; the more prevalent cheap-to-buy and expensive-to-maintain class of American car has had a much wider vogue and tends to prejudice public opinion against American cars in general, in spite of the fact that the standard of American construction in this line has of late improved greatly.

In the sugar machinery market experience has undoubtedly been somewhat analogous. Those who have had occasion to compare the best British machinery of bygone days with the contemporary American machinery have frequently had good cause to prefer the former, the American mill having been too frequently extremely light and unreliable. Consequently in Cuba, mills made in the United Kingdom were preferred by the owners of factories to mills made in the United

States; indeed, previous to the intervention of the latter in Cuban affairs practically all the first class houses in Cuba were equipped with British mills. But with the introduction of American capital in that island the demand naturally grew for American plant, and as the latter has improved greatly of late years its extension has been considerable.

As regards particular designs, there is also this to be observed. British makers were slow to realize the advantages of the big multiple mill, and it was left to American makers to lead in their introduction. The results warranted an extension of this type and American machinery houses have ever since been to the front in such production. Even here, though, it is claimed that their success has been due to their basing their principal dimensions on the more durable British practice. On the other hand, even among American expert advisers there are not lacking those who hold that the smaller American cane mills do not compare as favourably as do their larger outfits with European machinery, and as a consequence, where the delivery restrictions will allow, the European type is still preferred by firms who want an up-to-date and substantially constructed equipment of moderate output.

It may be the case as stated by the Fulton Co. that certain mills of British construction are now being replaced by new American machinery; but in view of the age of some of these British mills[1] the fact would not be in the least surprising, as the demand nowadays for mills of large capacity to deal with greatly extended areas of canes would make the retention of the older plant unremunerative in most cases.

But, as we remarked above, the most pressing factor which at present influences the placing of new orders for sugar machinery is that of prompt delivery, so as to take advantage of the large profits that accrue while sugar is at its present high price. There has been phenomenal activity in Cuba as elsewhere to get new plants and so increase the areas of cane grown and the sugar produced; and in view of the demands of the military authorities in Europe on the engineering shops of sugar machinery makers, it was a foregone conclusion that the bulk of all recent orders for plant would go to America. With sugar prices as they are at present it is quite conceivable that even badly designed machinery, which would need to be scrapped after the war, can be made a paying proposition just now. The profits of one or two crops would doubtless wipe off the cost of the new machinery and still leave a handsome balance.

After the war, while competition will remain very keen, we opine that American makers will no longer have it so much their own way. Indeed in the opinion of some observers, there is little doubt that when British cane sugar machinery manufacturers are in a position to revert from war work to their customary speciality, the quality of their mills will soon raise them to their old pre-eminent position. Be this as it may, the inevitable competition that will result will be all to the benefit of the mill owner of that day.

* * *

Proposals submitted by the Russian Minister of Finance for the temporary remission till next September of the Customs duty on imported sugar have been approved by the Russian Government. They stipulate that a quantity of sugar not exceeding about 322,500 tons shall be admitted free of such tax and only be liable to the excise duty as levied on all native Russian sugar.

---

[1] Vide the 40-year old mill at St. Croix referred to in our October 1916 issue, p 443. There is also a case in Cuba of a Mirrlees mill made in 1851 which ran till a year or two ago and then was replaced by a modern American mill.

Notes on American Sugar Production.

(From our American Correspondent.)

At the present time every field of sugar production within American territory is enjoying a period of prosperity which naturally is leading to increased production. Quite the most remarkable progress in this direction, however, is being scored by the beet sugar industry. Perhaps this is because it has the most room for growth, for the Department of Agriculture has estimated that there are in the United States no less than 274,000,000 acres adapted to sugar beet growing, while the total area planted to beets this season, although the largest in the history of the industry, is only 768,000 acres, or less than one acre in 350 of the available total. The cane growing sections of the South, Hawaii, Porto Rico, or even the Philippines, present no such field of potential expansion as this.

Without going too much into the history of the American beet sugar industry, it may be remarked that its real growth dates from the year 1897, when the Dingley Tariff Law placing a protective duty on sugar was enacted. The production of sugar from beetroot in 1898 was 32,000 (long) tons. For the present season the estimated production is 815,000 tons, which represents an increase of over 2400 per cent. in eighteen years. The subjoined table shows the production year by year since 1900:—

1901	76,859	1909	380,254
1902	164,897	1910	457,562
1903	195,004	1911	455,511
1904	214,825	1912	535,368
1905	216,173	1913	620,131
1906	279,392	1914	654,822
1907	431,797	1915	644,690
1908	413,954	1916	815,000(estimated)

It will be noted that the year 1915 showed a decrease in production as compared with 1914, a condition traceable to the free sugar clause of the Underwood Tariff Law which was scheduled to take effect on May 1 of the present year. Following the enactment of this measure eleven beet sugar factories that had been in operation were closed. While it was reasonably certain before the close of the last planting season that the free sugar provision of the law would be revoked, a number of these factories were unable to reopen during the present season. Practically all of them, however, will be in operation another year and, in addition, a dozen new factories are under construction which will bring the total number up to 90, while a number of others are projected which may or may not progress rapidly enough to begin operation during the next campaign.

One of the serious obstacles to the early progress of the beet sugar industry in the United States was the prejudice among the farmers against beet growing which had to be overcome. The American farmer, particularly in the West where the beet industry has made its greatest growth, is accustomed to extensive rather than intensive cultivation. He favours crops which can be handled largely by machinery, with a minimum of hand labour. In most cases the farmers did not have at hand the labour needed for thinning and cultivating the beets.

To meet this condition the beet sugar companies undertook to supply the farmers with seed and to provide, either directly or through sub-contractors, the hand labour necessary for cultivation. They also furnished the services of skilled agriculturists to advise the farmers as to the handling of their beet fields.

This system has persisted, although in communities where the industry has been established for a number of years it is no longer difficult to persuade the farmers to grow beets. Aside from the attraction of beetroot as a fairly certain and highly profitable cash crop, the farmers have found that by growing beets in rotation with their other staple crops such as wheat, corn and oats, they are able to increase the yield of the latter by some 25 to 50 per cent., so that they have a double reason for favouring beetroot cultivation.

Another factor encouraging the expansion of the acreage devoted to this crop at present is the attractive prices which the beet sugar companies are able to pay the farmers with the present high value of sugar. The prevailing price for beetroot this season is six dollars the short ton, and most of the companies are increasing this figure from fifty cents to a dollar the ton for the coming season. With this stimulus there undoubtedly will be a marked increase in the area devoted to beetroot cultivation during 1917.

Russian Sugar Notes.

The enactment of the decree of the 23rd October, admitting 20,000,000 poods of sugar duty free during the period extending to 14th September, 1917, furnishes an occasion for reviewing the position of the Russian sugar industry and trade during the past few years, and estimating its prospects for the immediate future. As a direct consequence of the war the sugar industry has been put into a remarkably difficult position. Its supplies of raw material have been curtailed, and the cost has been greatly augmented, whilst labour has been scarce; and, owing to transport difficulties, deliveries of raw material to the factories and of finished sugar to the consumers, have been most imperfectly effected. From every point of view the state of the sugar trade can only be described as abnormal: and it may be said that the only parties in it that can contemplate its present situation with any satisfaction are those who hold sugar, whether they be factory owners or speculators; for the price has risen so high as easily to cover the cost and leave an excellent margin of profit to the sellers. The position is very clearly explained in a statement just issued in Petrograd on the sugar question generally.

The Russian production of sugar has been marked since the beginning of the war by successive declines. The area devoted to beetroot growing has been reduced, the quantity of sugar produced from the beetroot has decreased, and the quantities or balances carried over from one campaign to another have been successively smaller: and all the time the demand for sugar on the inland market has been growing, notwithstanding the difficulty in procuring the article, and the great rise in price. In the year of the opening of the war the total quantity of beetroot sugar produced was 104,718,921 poods: in the second year of the war the production shrank by 13,432,165 poods, making only 91,286,756 poods: and the third year of the war works out with a reduced beetroot growing area from 670,124 dessiatines in 1915 to 589,862 dessiatines in 1916, and the collection of beetroot shows an estimated decline of 100,781,000 poods, from 715,992,000 poods in 1915 to 615,211,000 poods in 1916, presaging of course a further considerable decline in the production of sugar. Thus, according to data collected by the managers of the Pan-Russian Sugar Manufacturers Company, on 1st October (o.s.) the sugar production was expected to yield 13·7 per cent. of the weight of the roots. That is to say, 65·7 funts per 12 poods, or berkovetz, which would give a total quantity of 84,096,000 poods (1,355,300 tons).

Along with the reduction of the quantity of sugar available it is observed that the inland demand for sugar has considerably increased. In the first year of the war, stimulated by the mobilization of the military units, and by the suppression of the traffic in vodka, the national spirituous drink, the increase in the demand for sugar in the country made a big jump upward of about 10,000,000 poods, from 84,515,018 poods in the 1913-14 campaign to 94,482,421 poods in the 1914-15 campaign. In the succeeding year, there was not such a striking increase in the demand: but it was important enough, and was the more remarked on in Russian sugar circles, as the sugar producers expected a reaction, that is to say, a considerable decline compared with the preceding campaign as a result of the difficulty that had been experienced in delivering the sugar to the various markets. In the event there was an increased demand, measured by about 5,500,000 poods. If we take for the current campaign the demand for the inland market, along with what is required to satisfy the demands of the Persian and Finland markets, to be about 105,000,000 poods (say 1,700,000 tons), then the deficit expected in the current campaign's production, *plus* the small balances carried over from the operations of the preceding campaign, works out at about 15,000,000 to 20,000,000 poods (say 242,000 to 322,000 tons).

As a balance had to be struck and the difference made good on behalf of the national economy, an examination of the situation showed that this could be accomplished in only one way, namely by the importation of sufficient sugar to make up for the expected shortage. What prevented the importation of sugar before was the high tariff wall erected to prevent it. The decree referred to suppresses the tariff for the period and quantity specified, but the importers of sugar will pay the same excise as is paid for sugar made in the country.

Thus the outlook for sugar if the present campaign should run normally is poor enough. But it has begun very badly. The beetroot has not been delivered to the factories either regularly or proportionately to the quantities collected in the fields, and when we add to this the serious shortage in labour owing to the large numbers of workers called to the colours, it is easy to understand that the initial months of the 1916-17 campaign indicate clearly enough that the production of sugar must not be expected to correspond to the quantity of beetroot either sown or gathered. The number of factories working is of course considerably smaller than in preceding years, but they are of sufficient capacity to have handled all the beetroot easily enough, if it had come forward in time. It will be remarkable indeed if a further Ministerial decree has not to be issued increasing the quantity of sugar that may be imported duty free. Such is the position of the sugar industry to-day.

Presuming a continuance of the war with a further drain on the labour of the country, and corresponding uncertainty in the minds of the beetroot cultivators, one may wonder whether a further reduction in the beetroot area may not have to be registered during 1917. But perhaps it is better to leave the future to speak for itself. The present constitutes sufficient for a study. The sugar industry will require great vigour and unremitting vigilance to ensure a production in this campaign approaching the estimate, whilst the question of distribution will undoubtedly give much cause for anxiety on the part of both the transport services and the consumers.

The British Sugar Commission has had to consider all sorts of applications for supplies of sugar, but it is hard to see the justification for refusing to grant special facilities to pharmacists for obtaining sugar for the making of lozenges and tablets of a medicated character.

The Sugar Trade of 1916.[1]

The Royal Commission on the Sugar Supply, which has continued to exercise entire control of the British sugar market during 1916, has successfully overcome all difficulties of freight and exchange and has succeeded in keeping the refineries of London, Liverpool and Greenock in full employment. This has been no easy task, as supplies coming from Java have been of uncertain arrival, owing to their having to follow sea routes dictated by the exigencies of war.

The principal source of the raw sugar supply has however been Cuba, where under the stimulative influence of a highly remunerative price the crop has been exceeding all records. When it is considered that the average price of Cuba's last pre-war crop, basis 96°, was about 8s. to 9s. per cwt. f.o.b., and that during the past year it has averaged about 18s. to 19s. per cwt. f.o.b., it will be seen how great the inducement has been for the Cuban planter to extend his cultivation and how financially capable he is to equip his estates with plant of the newest and most improved description. It is thought not unlikely that Cuba may follow the lead of Java, and adapt her centrals to the manufacture, in part, of white sugar suitable for direct grocery consumption.

Java came next in contributing to our raw sugar supply. The present crop has been somewhat reduced by drought, but that now maturing gives promise of proving a record, namely 1,560,000 tons against 1,198,000 tons in 1916. The proportion of white sugar now manufactured there is of excellent quality and is readily saleable for grocery purposes.

The entire production of Mauritius crystals, amounting to well nigh 200,000 tons, was secured by the Royal Commission; but under an arrangement entered into with the French Government early in the year, to make purchases on combined account, the cargoes of these sugars as they come forward are being ordered to French ports.

Our own West Indian Crown Colonies have proved disappointing, and notwithstanding remunerative prices they have shown little or no expansion in their cultivation. It is well understood that they are capable of raising greatly increased crops—that Jamaica, now producing only 15,000 tons for export, could be made to yield 40,000 to 50,000 tons, and that British Guiana, with its present crop of 120,000 tons, possesses sufficient area for immense extension. It would appear, however, that without guarantee of security against unfair competition in the future, the requisite capital for such extensions cannot be obtained.

The full American sugar duty on importations from neutral countries is equivalent to rather over 5s. 9d. per cwt., basis 96°, with a preferential reduction of 20 per cent. on Cuban sugars, and with freedom from duty on home-grown beetroot, and cane sugar from Louisiana and the American Colonies. These preferential and free sugars are, however, sold on a duty-paid basis, and in that way enjoy a substantial bounty. It is interesting to observe the development of these crops under the fostering influence of preference. Porto Rico, which, before becoming an American colony in 1898, produced only 50,000 tons, has now a crop of 450,000 tons; Hawaii, with formerly 225,000 tons, has now 575,000 tons; while United States beetroot, which then yielded only 35,000 tons, is now estimated to produce 840,000 tons.

The consumption of sugar in the United Kingdom in 1913, the pre-war year, was about 1,800,000 tons, of which 940,000 tons were produced by our own refineries, and the remaining 860,000 tons were refined sugars imported chiefly from Germany and Austria. The consumption for the past year has been reduced to about 1,400,000 tons, of which about 850,000 tons have been from our own refineries, and 550,000 tons have been from importations and stocks of white Java, American granulated, and Mauritius crystals. The market could readily have absorbed a much larger quantity of refined, but, from freight difficulties and other causes, importations were restricted by the Royal Commission.

---

[1] Abridged from the Annual Review published by Messrs. William Connal & Co of Glasgow.

During the greater part of the year special licences were granted by the Commission for the importation of cane sugars, not exceeding 89 per cent. polarization, more particularly from Brazil and Manila. These were intended to supply the wants of brewers and of the general trade. Considerable stocks of the Manila, thus imported, were warehoused in London awaiting a market, and were gradually being disposed of at from 17s. to 17s. 3d., c.i.f., or at the equivalent of 26s. to 26s. 3d., duty paid. More recently, however, the great scarcity of refined sugar in London developed a strong demand for these descriptions for domestic consumption, and prices experienced a continuous advance, resulting latterly in sales of Nos. 3 to 5 Ilo Ilo, Manila, at the unheard-of prices of 44s. 6d. to 45s. 6d., duty paid. The stocks of these brown sugars have now been well nigh exhausted, while the Royal Commission has lately prohibited all such importations except for brewing purposes alone.

On 4th April the Chancellor of the Exchequer raised the duty on sugar to a range of 6s. 9d. to 14s. per cwt., according to polarization. Prior thereto the duty had ranged from 4s. 6d. to 9s. 4d. per cwt., to which it had been raised on 21st September, 1915. To find a parallel to the present duty it is necessary to go back to the time of the Crimean War. On 21st April, 1855, the duty was increased by 25 per cent., which made it 13s. 9d. to 15s. per cwt. The price of "good to fine loaves" (there was no granulated sugar in those days) was then 51s. to 54s., but, later, deficiency in supply led to active buying, and, in November of that year, the price had advanced to 76s. to 81s. per cwt., duty paid. The price of finest granulated sugar to-day is 41s. 7½d. per cwt., duty paid.

Sugar-House Condensing Systems.

By FRANK COXON.

Valuable treatises have already been published on Condensing Systems in general, describing in detail all the methods of producing a vacuum and condensation; it is therefore not within the scope of these notes to go over again the ground covered by these works.

What is intended here is merely to give a few comparisons of the merits of some of the more usual types and systems found in sugar-house work, with a few figures on their general proportions.

There are four distinct types or systems that can be called common practice:—

(1) Single jet condensers with horizontal wet displacement pumps;

(2) Barometric condensers working with dry air pumps, rotary and reciprocating;

(3) Multiple jet condensers working with rotary air pumps and usually at a low level;

and (4) Rotary condensers and air pumps combined, taking in vapour and incondensible gases at one inlet, condensing water at another, and expelling the mixture at one outlet.

It is, however, not an infrequent occurrence to find a compromise between two systems working, as will be seen later.

SINGLE JET CONDENSERS AND WET DISPLACEMENT PUMPS.

This system, the oldest in sugar-house practice, still holds its own for small units up to about a vapour capacity of 6000 lbs. per hour, and is likely to meet all requirements consistent with practical economy for most plants up to this figure.

The two great disadvantages of this system are: (1) Extravagance in steam consumption; and (2) heavy consumption of cooling water. The pumps having to handle water in bulk are necessarily compelled to run at a slow speed owing to the peculiar construction and design. This means a very large steam cylinder, bringing in its train heavy condensation and other losses common to such sources of inefficiency.

The condensers on account of their simplicity, using merely a single jet or ring, are compelled to use larger quantities of water than are really necessary, quite 25 per cent. getting away without doing useful work, and when compared with present up-to-date practice being something like 50 per cent. in excess of such. Where practical rules give, say, 40 lbs. of water per lb. of vapour for modern plants, the wet displacement system would require 60 lbs.

It is inconceivable in the light of present day experience that factories, of which there are many, should still use this system when handling quantities of vapour like 22,000 lbs. per hour. Many factories have from time to time put down extra evaporators, pans, etc., and installed with them separate units of condensers and pumps on the single jet system, it being a frequent state of affairs to find four or five pumps working independently of one another.

Great difficulty is experienced in convincing those responsible that a more modern system would nearly pay for itself in a crop by the advantages accruing from reduction in steam consumption and water troubles.

For small duties however the wet displacement single-jet system is used with comparative success on account of the low maintenance and running costs which balance many objectionable features.

Proportions of condensers.—The following are practical figures found in use:—

	Lbs of vapour per hour 1,000	 10,000
Cub. ins. capacity of body per lb. of vapour per hour .	15 ..	7½

Intermediate sizes being based on these two limits. Length of body is usually two-and-a-quarter times the diameter.

Injection water.—The amount of water necessary is worked out from the following simple formula:—

$$\text{Gallons of water per hour} = \frac{\text{Lbs of vapour per hour}}{10} \times \frac{\text{Total heat in 1 lb. vapour} - T_f}{T_f - T_e}$$

T_f = temperature of tail water.

T_e = temperature of water entering.

Very few plants are able to show a tail water temperature as near the vacuum temperature as 20° F. and taking this figure as a practical one, a 26½ in. vacuum and water at 80° F., the amount of injection water would be as follows:—

$$\text{Gallons per hour} = \frac{\text{1 lb. of vapour}}{10} \times \frac{1151 - (120\text{-}20)}{100 - 80}$$

$= 5{\cdot}3$ gallons to 1 lb. of vapour

or 53 lbs. per lb. of vapour.

The temperature of the tail water being (vacuum temperature — 20°).

It is the usual practice, however, to allow 60 lbs. of water unless abnormal conditions of the cooling water prevail, such as would result from low capacity cooling towers.

Suction pipe.—This should have ample area and can be satisfactorily worked out as follows:—

$$\text{Area of pipe in sq. ins.} = \frac{\text{lbs of vapour per hour}}{230},$$

to which must be added, when the corresponding diameter is found, a sum of ¾ ins. to allow for frictional losses.

This is applicable to usual conditions of pipe lay-out which have a suction lift of from 10 to 14 ft. and a pipe length of from 50 to 100 ft. When greater heads or lifts and lengths of piping are used it is advisable to allow liberally for these contingencies.

Pumps.—The proportions of the pumps are usually set out as follows:—

Diameter of pump	18 in.	36 in.
Piston speed, ft. per min...	180	220

Gross displacement per 1000 lbs. vapour per hour or piston speed × area of piston = 70 cub. ft. per min.

Ratio of Steam Cylinder to Pump Cylinder		Vapour per hour. Lbs
1 — 1½	....	1,000
1 — 2	....	10,000

Where definite high steam pressure can be guaranteed, then, of course, special calculations are necessary, but the latter proportions given are suitable for steam pressures down to 50 lbs. with a back pressure of from 5 to 7 lbs.

Centralization.—It is frequently the case to find an evaporator and pan coupled up to one unit of condenser and pump, which is a very efficient method of working for small plants; for large capacities the pumps become abnormal in size, and individual condensing equipment is desirable.

Dry pumps.—It is a common practice to use these wet displacement pumps, when discarded from "wet" systems, as pumps to extract the air from barometric condensers, and thus "save" the cost of a new dry air pump when converting a "wet" system to dry or barometric.

The water in the pump is still used, but here it acts solely as a seal and is made up, to allow for losses, by a continual dribble from a small pet cock on the cold water supply. Under these conditions it is quite safe to increase the speed of the pump about 10 per cent. Needless to say, the hopeless wastage of steam is obvious in churning continually that large body of water, and the extent of this wastage is gone into later.

The capacity of such a pump is worked out on similar lines to that of an air pump on the dry system also shown later, but an additional margin of 20 per cent. is allowed for to cope with losses from large clearance volumes.

BAROMETRIC CONDENSERS.

This type of condenser is the most efficient and most widely used one in sugar-houses, and possesses four distinct advantages:—

(1) Low water and steam consumption.
(2) Centralization of evaporators and pans now possible, as the air pumps are of rational size for even very large capacities.
(3) High vacuum easily obtained.
(4) Immunity from attack by foul cooling water resulting from cooling tower work.

They are built in varied forms, the chief being counter-current type and parallel flow type, but it is sufficient to state here that the best and most efficient designs should comply with the following points in construction:—

(1) The vapour should enter at the bottom and the air or incondensible gases be extracted from the top, the water being delivered at the top and thus forming a counter-current.

(2) The extraction of the air should be arranged so that the air leaves the condenser where the water enters, thus obtaining an advantage in the reduction of the temperature of the air and a consequent reduction in volume, giving the air pump less work to do. This difference between the extraction of the air at the top and the extraction at a place where the water is hottest means often something like 8 per cent. of the volume.

(3) There should be arrangements for sub-dividing the water into as small particles as possible, consistent with the production of normal size bodies.

Sheets of water are not efficient, the vapour bursting through in gulps and allowing large amounts of water to get away unused.

The first-mentioned point in design, counter-current, is now universal, and only in special cases is any other type employed. The second point is also well considered by makers, and each claim some or other special features in this line over its competitors. The third feature of design, by far the most important, represents truly the efficiency of the condenser as regards its water consumption.

There are two first-class designs on the market, one using rain trays and alternatively trays giving concentric flat ribbons of water, the other using concentric flat ribbons only but in series. This division of water by concentric flat ribbons of liquid has advantages over all other types in so far that the capacity of the condenser is reduced to a minimum, and the vapour passing in and out through thin walls or ribbons of water is now compelled to give up its heat in the quickest and most efficient manner possible.

Those condensers fitted with concentric baffles or flat plates from which the water falls in circular sheets from one to the other, should be avoided, as while they may be cheaper in first cost they are not nearly as economical in water consumption as the flat ribbon form of division.

Some makers use only a single ring of dividing holes, but this is not good practice as the vapour has not time to be thoroughly exhausted of its heat unless excessive water volumes are used.

Proportions and capacity.—Gross capacity = 11 cub. ft. 1000 lbs. of vapour per hour. Length of body = diam. × 2 with a minimum length of 8 ft.

Vapour inlet.—This is usually based on a vapour speed of 150 ft. per second, and varies considerably according to makers' practice. An interesting point in connexion with calculations on this matter is the volume in cub. ft. per lb. of vapour. Very little regard to the difference between the volume of a lb. of steam at 26 in. vacuum and that of a lb. at 27½ in. vacuum used to be taken when working out vapour piping, although it is obvious from any steam table giving properties of saturated steam in terms of vacuum and volume per lb. Such a table, however, in compact form and arranged for direct reading in connexion with condensing calculations is difficult to find, and the accompanying table arranged by the writer will be seen to be a most useful one both for vapour pipe calculations as well as for injection water problems. A vacuum of 26 in. gives 178 cub. ft. per lb. of steam, whilst one of 27½ in. gives 282 cub. ft., nearly 70 per cent. more, meaning that a pipe designed on a 26 in. vacuum could not possibly pass the steam at full duty when worked at 27½ in. vacuum.

Modern designers and engineers have, however, a tendency now to give this matter more consideration, and it is not an infrequent thing to see specified that large vapour pipes are to be supplied of ample size for the duty when working at 27 in. to 27½ in. vacuum.

Properties of Saturated Steam below Atmospheric Pressure.

Ins. of Vacuum.	Temperature deg. F.	Absolute pressure, lbs sq. ins.	Volume, cub. ft. lb.	Total Heat from 0° F.
0	212·00	14·70	26·6	1178
½	211·15	14·45	26·9	1178
1	210·29	14·21	27·3	1178
2	208·54	13·72	28·1	1177
3	206·73	13·22	29·0	1177
4	204·86	12·73	30·1	1176
5	202·94	12·24	31·3	1176
6	200·95	11·75	32·5	1175
7	198·89	11·26	33·7	1175
8	196·75	10·77	35·1	1174
9	194·53	10·28	36·7	1174
10	192·23	9·78	38·3	1173
11	189·81	9·30	40·4	1172
12	187·30	8·80	42·5	1171
13	184·66	8·30	44·8	1171
14	181·88	7·82	47·2	1170
15	178·96	7·33	50·3	1169
16	175·87	6·84	53·8	1168
17	172·59	6·35	58·1	1167
18	169·07	5·86	63·0	1166
19	165·31	5·36	68·2	1165
20	161·25	4·87	75·0	1164
21	156·83	4·38	83·0	1162
22	151·97	3·89	92·7	1160
23	146·55	3·41	104·0	1159
23½	143·59	3·16	112·0	1158
24	140·42	2·92	120·5	1157
24½	137·01	2·07	131·0	1156
25	133·32	2·43	143·0	1155
25½	129·31	2·17	160·0	1154
26	124·89	1·93	178·8	1153
26½	119·94	1·68	203·0	1151
27	114·34	1·44	236·8	1150
27½	107·84	1·19	282·8	1147
28	100·05	0·94	356·6	1145
28½	90·24	0·69	515·2	1142
29	76·80	0·45	660·0	1138
29½	54·21	0·21	833·0	1132

Fall pipe.—The area of the fall pipe is made 2¼ times the area of the injection water supply, based on the centrifugal pump supply, or about 6 per cent. of the diam. of the condenser body. The length from water level of tail race to commencement of cone bottom should be 33 ft.

Injection water.—The amount of water is found by the formula given for that of jet condenser work, but as the mixing of the water and vapour is so complete, the tail water is found on first class plants to be only 6° F cooler than the temperature of the vacuum. With low temperature water and good equipment, this has been reduced to 4° F, but the average is about 10° F.

Taking water at 80° F, the amount of water would come out for 26½ in. vacuum as follows:—

$$\text{Gallons of water per hour} = \frac{1 \text{ lb. vapour}}{10} \times \frac{1148 - (120^\circ - 10^\circ)}{110^\circ - 80^\circ}$$

$$= 3{\cdot}4 \text{ gallons per lb. of vapour, or } 34 \text{ lbs. per lb. of vapour.}$$

For higher vacua it will be found that considerably more water is required; a very practical figure often used is 45 to 1, the temperature of tail water being (vacuum temperature — 10°).

Dry air pumps.—The amount of air and incondensible gas to be extracted from condensing apparatus has received a great deal of attention from authorities on this matter, and an average figure for practical use can be taken as 22 per cent. of the injection water by volume. Certain sugar-house practice is to allow from 5 to 7 lbs. of air per 1000 lbs. of vapour, American manufacturers in some instances using 5 lbs. and European ones 7 lbs. The first method is perhaps the most correct, dealing directly with the source of supply, i.e., the injection water. A certain proportion of the air is due to leaky joints, but the bulk can be traced to entrainment. It is usual, however, to use these figures only on rotary pumps, the reciprocating patterns taking an empirical figure of their own found by practice.

Air pumps of the dry system are made in various forms, but the three chief ones found in general use are as follows:—(1) Horizontal reciprocating pattern; (2) Vertical reciprocating or Edward's pattern; and (3) Rotary type.

The horizontal pattern is well known and needs little description here. A gross capacity displacement of 36 cub. ft. per min. is usually allowed for every 1000 lbs. of vapour per hour, and the pumps run from 200 to 400 ft. a min. in the smaller and larger sizes respectively.

Special care should be taken to see that the slide valves of the air cylinder are fitted with equalizing parts, this feature playing a very important part in the efficiency of the pump by exhausting the clearance spaces at each end of the stroke. At one time a frequent source of trouble to dry air pumps was the entraining of water into the air cylinder. All barometric condensers are now fitted with efficient separators, some internal and some external, both types being usually well designed.

The usual practice in the ratio of steam cylinder area to pump area is from 1 to 2½ and 1 to 3, differing according to the standards adopted in the lowest effective steam pressure, at which the pumps will satisfactorily run. A mean will usually do all the work required at 55 lbs. per sq. in. and a back pressure of 5 lbs.

Air suction pipe.—This is very often based on a speed of from 60 to 90 ft. per second, due regard being taken to the length of suction pipe and diameter. A long pipe, used where the pump is remote from the condenser, may cause a serious reduction in vacuum through the friction in the pipe absorbing, as has often been observed, inches of vacuum. In calculating the size of the pipe it is usual to take the gross displacement of the pump as the amount of air to be extracted, but allowance must be made for the expansion from atmospheric pressure to the vacuum used and is proportional to the absolute pressures.

Taking a vacuum of 27 in. the absolute pressure is 1·44, and the absolute pressure of the atmosphere at 30 in. barometer is 14·7; the ratio of expansion, then, will be 1·44 to 14·7, or $14{\cdot}7 \div 1{\cdot}44 =$ say 10. That is, the volume of air for pipe calculations to be extracted will be for 27 in. vacuum, 10 times the displacement of the pump.

Similarly for a 28 in. vacuum, $14{\cdot}7 \div 0{\cdot}94$ the absolute pressure of a 28 in. vacuum $=$ say 16. It will be obvious again, as shown above, how these high vacua affect the proportions of piping and orifices.

(To be continued).

Cane Planting in Single and Double Row.

By ARTHUR H. ROSENFELD.

In subtropical cane-growing countries, notably in Louisiana and the Argentine, it is the custom to plant the entire cane in at least two rows, at times these rows being lapped where the two canes meet. It is usually customary to use in this type of planting about four tons of cane, which, in Louisiana, represents about 20 per cent. of the product of an acre and in the Province of Tucumán about 50 per cent. Now, when one examines a cane plant and sees that a metre of this plant will carry on the average about eight eyes, he is inclined to wonder if it is necessary to put into the ground sixteen to eighteen eyes to secure good germination, above all when four plants per metre ought to give a splendid yield. The question, then, naturally suggests itself, "If the plant cane were well selected and if practically all the eyes put into the ground were good, would not as good a yield be secured by planting one row of cane as two or three?" In other words, only a certain number of plants can mature to their maximum size and sugar content in a row, and one naturally wonders if this maximum number could not be secured with less expense for valuable planting material. It might very well be that the plant cane might not give quite as high a yield, if planted with one row of cane, as that planted with two or two and one half (if the canes are well lapped), but will that difference in yield be such as to compensate us for the two additional tons of raw sugar material that we have placed in the ground, above all if the ratoons are able to produce us an equal amount of cane in one case as in the other?

In order to get at some sort of definite reply to these questions, experiments were begun at the Tucumán Sugar Experiment Station in the year 1913 with two distinct types of sugar cane, the D74, which has given such excellent results in the Louisiana cane districts, and a Japanese forage cane of the *Zwinga* variety.

These two experiments were made in distinct plats, being planted in August as succession cane, after the land had been well ploughed with a 26 in. plough and harrowed with an ordinary tooth harrow. The rows were indicated with a small share plough, deepened with a double mouldboard plough, and covered with the small share plough. One half of each lot was planted with single rows of cane and the other half with double continuous rows without lapping. All cultivation, irrigation, etc., was identical in both lots and was as follows:—

September 17th, 1913	Dirt knocked off the rows with spades.
October 7th, 1913	Irrigated.
October 14th, 1913	Four-tooth cultivator sent twice through each middle, with teeth or shares set in such a way as to throw a little dirt toward the centre.
October 16th, 1913	This cultivation was repeated after two days, as the middles were very weedy, and on the 28th the small "Planet Jr." cultivator No. 43 was sent through these middles once, leaving them in good condition. This machine was again sent through on
December 3rd, 1913	And on
December 6th, 1913	The rows were weeded with spades.
December 12th, 1913	A mixed fertilizer, consisting of 50 per cent. dried blood, 40 per cent. superphosphate of lime, and 10 per cent. sulphate of potash, was applied in the rows by hand, at the rate of 600 kg. per hectare, and covered with a small share plough.

December 30th, 1913	Cultivated the middles with a four-share cultivator and the rows with a six-disc straddling cultivator.
January 21st, 1914	Laid by with disc cultivator.
January 31st, 1914	"Planet Jr." cultivator No. 80B sent once through each middle.
August 24th, 1914	Harvested.
September 15th, 1914	Middles ploughed out by making four furrows with large share plough.
September 18th and October 3rd, 1914	Irrigated.
November 12th, 1914	Middles cultivated with "Planet Jr.," No. 43.
November 27th, 1914	Rows weeded with spades and fertilizer applied as in 1913.
December 5th, 1914	Same as *November 12th.*
January 12th, 1915	Rows weeded with spades.
January 18th, 1915	Middles cultivated with "Planet Jr.," No. 80B, and rows with discs.
July 14th, 1915	Harvested.
1915-1916	Practically identical with cultivation of 1914-15. For *D74* only.

It is perhaps needless to say, as we are treating of experimental work, that all cane was carefully selected and that the same type of cane was used in each lot with each variety.

Germination.

Some interesting data on comparative germination of the lots were obtained by counting all plants above ground during the months of October and November, 1913 (plant cane). Table I gives us the results of these counts—figures which speak for themselves:—

TABLE I.

Comparative Germination.

Rows.	Oct. 23rd.	Oct. 29th.	Nov. 5th.	Nov. 13th.	Nov. 21st.	Crop.
			A. D74 Cane.			
Single	81	89	103	142	190	682
Double	137	157	198	258	320	862
			B. *Zwinga.*			
Single	—	190	219	238	308	526
Double	—	292	330	348	399	698

A glance at this table shows us that, as was to be expected, the cane planted in double row has given us many more plants than that in single. We note, also, that the advantage continued after sprouting had begun and that, in each case, the number of plants at the time of cropping was very much greater per row in the cane planted in double row than in single. A paper recently read by Dr. C. W. EDGERTON before the Louisiana Sugar Planters' Association throws some light on the necessity for a greater quantity of plant cane in more or less temperate climates than in tropical ones and explains why our double row plantings may be expected to give best results in such climates. He shows that, grown under normal tropical conditions, there is no rest period between the reaping of the ripened cane and the planting of the new, whereas, in countries such as Louisiana or the Argentine Republic sugar district, a rest period of three to four months ensues. This is particularly so here in Tucumán where cane planted last May has had to pass through a cold winter followed by an unusual drought and as yet, at the end of

November, is very little germinated—a rest period of over six months. Dr. EDGERTON calls attention to the fact that, during such periods, the cane buds have to lie more or less dormant, protected by soil; but as the buds are not specially adapted for this, they are very likely to suffer from disease attacks and adverse soil conditions, which, most naturally, greatly affect their germinating conditions. In fact, Dr. EDGERTON found from experiments carried on in Louisiana that the surprisingly small amount of only 15 per cent. to 30 per cent. of the buds will reproduce stalks! It is well to bear these conditions in mind when considering the present experiments.

RESULTS OF THE EXPERIMENTS.

Our germination counts have already indicated to us more or less the results at the time of harvest of the plant cane, i.e,, if the average stalk weights be more or less equal at the time of cropping. Let us see, now, just what figures the crops actually furnished us in each case, bearing in mind that the *Zwinga* cane represents more or less the new type of luxuriant growers which are now being adopted in Tucumân in the shape of the Java canes recommended by the Tucumân Sugar Experiment Station, and that these results, hence, are of immediate application to the Tucumân sugar industry, although Dr. W. E. CROSS, the capable new director of that institution, has commenced actual experiments with these Java canes along this same line. For the data contained in Table II. the writer is very much indebted to Dr. CROSS.

TABLE II.

YIELDS AND ANALYSES.

		Stalks		Yield		Chemical analyses of juices.					
Rows.	Age	Per 100 metre row.	Av weight kg	Per 100 metre row kg.	Per hectare kg.	Brix.	Sucrose.	Glucose.	Purity.	Manufacturing value [1]	Kg. Available sugar per hect. [2]
				A. D 74 Cane.							
Single	Plant	855	0·79	682	45,467	15·6	12·3	0·4	78·9	9·7	3087
,,	1st ratoons	1125	0·71	796	53,067	14·7	11·7	0·6	79·6	9·3	3454
,,	2nd ratoons	1038	0·47	491	32,708	12·7	8·7	1·0	68·5	6·0	1374
,,	Average	1006	0·65	656	43,747	—	—	—	—	—	2638
Double	Plant	1074	0·75	862	53,467	15·7	12·7	0·4	81·4	10·3	3855
,,	1st ratoons	1262	0·72	910	60,667	13·5	9·5	0·9	70·4	6·7	2845
,,	2nd ratoons	1242	0·48	600	40,000	12·2	8·5	1·1	69·7	5·9	1652
,,	Average	1193	0·65	771	51,378	—	—	—	—	—	2784
				B. *Zwinga.*							
Single	Plant	1712	0·32	526	26,300	16·7	13·0	0·5	77·8	10·1	1859
,,	1st ratoons	3616	0·43	1568	78,400	15·5	10·4	1·6	67·1	7·0	3842
,,	Average	2664	0·39	1047	52,350	—	—	—	—	—	2851
Double	Plant	1824	0·38	698	34,900	18·5	15·1	0·6	82·1	12·4	3029
,,	1st ratoons	3688	0·46	1696	84,800	14·1	9·7	1·3	68·8	6·7	3977
,,	Average	2755	0·43	1197	59,850	—	—	—	—	—	3503

Before proceeding to study these results. it might be advisable to mention that the comparative results of the several years are entirely abnormal, as regards purities and yields, although, as far as our experiments go, they are perfectly comparable. It will be noted that, in almost every case, purities and sugar contents have dropped from plant canes to ratoons and from first ratoons to second. This is due to the fact that 1914 was the best crop year ever known in the history of the Province of Tucumán, there having been an entire absence of frost that and the preceding year, whereas 1915 was one of the poorest and coldest years and 1916 *the* coldest. Hence, whereas in Tucumán, as in all other sugar countries, ratoon cane generally furnishes a purer juice than plant, climatic conditions in these years has caused just the reverse condition.

---

[1] Obtained by multiplying the percentage of sucrose by purity.

[2] Calculated from a basis of 70 per cent. extraction on weight of cane.

The table shows that there is no doubt as to the advisability of planting two rows of cane in subtropical countries such as Tucumán and Louisiana, and that the additional amount of cane and sugar obtained by so doing many times recompenses the cost of the original two tons of cane additional per acre used in making this double planting. A notable fact, also, gleaned from the comparative analysis is that, in almost every case, the double row cane has given a superior analysis of juice to that of the same cane planted in single row, both as plant and first and second year stubble. As cane is a *sociable* plant, if such a term be permissible, and thick stands of this plant do not, apparently, prevent good maturity, this is not a surprising fact, although a strong argument for the obtaining, at almost any reasonable cost, of the most perfect stand possible.

Our average gain then, for the whole term of the two experiments, is about one ton of sugar per hectare, at present worth in the Argentine about forty pounds sterling, in favour of the cane planted in double row.[1] Even up to second year ratoons, the ratooning of the more thinly planted cane does not in any way compensate the original defect of stand.

In the light of these experiments we would advise sugar planters in countries having climates comparable to those of Tucumán and Louisiana to plant their cane in at least two running rows.

Volume of Air in Evaporator Condensers.

By JAS HAMILL

The question of partial air pressures and vapour tensions is of first class importance in connexion with condensers and air pump design. In recent years the subject has been forced to a greater extent than formerly on the attention of engineers in charge of condensing apparatus, but although the underlying principles are fairly well understood, cases arise which show that, even so, there is a lack of application of first principles to practice.

All forms of vacuum apparatus are fitted with some means for removing the air in the system, in the form of a wet air pump, a "dry" air pump, or more rarely an air ejector. The most common type is the so-called dry air pump, which is designed to remove the air only, in contrast to the wet pump which removes both the air and the injection water. That its name is rather a misnomer will be seen immediately.

The vacuum or absolute pressure existing in a vacuum apparatus is practically the same throughout the system, except for friction, or resistance to flow of the mixed vapour and air, the pressure being highest at say the vacuum pan and least at the pump. For the present, however, it will be simpler if the pressure be assumed as constant throughout.

If, therefore, the pressure be everywhere the same, the question arises as to the most suitable place for connecting up the pump, and the answer is, at the coldest part, for the following reason :—The pressure at any point is the sum of vapour and air pressures, and as the former is dependent on the temperature it can be readily determined from any good table of properties of steam. If the pressure so found be deducted from the total pressure in the system, the result will be the absolute air pressure, thus $PA = PT - PV$. An example will make the point clear. Suppose the vacuum be 28 in., corresponding to an absolute pressure of 0·94 lbs., and the mixture reaching the air pump be at a temperature of 80° F, the corresponding vapour pressure (or tension) at this point will be 0·5 lbs., which, deducted from the total pressure of 0·94 lbs., leaves 0·44 lbs. as the absolute air pressure at the air pump. At this pressure and temperature 1 lb. of air will occupy a volume of—

---

[1] Or, in English measurements, 8 cwt. per acre worth £16.

$$Va = \frac{13{\cdot}14 \times 14{\cdot}7}{0{\cdot}44} \times \frac{T + 80^\circ\text{ F}}{T + 60^\circ\text{ F}} = 455 \text{ cub. ft. per lb.} \qquad \text{(A)}$$

If now the volumetric displacement and efficiency of the air pump be known, the actual amount of air being exhausted may be calculated.

If, on the other hand, the air had been drawn off at a point having a temperature of 90° F, the pressures would be—

	Lbs.
Total absolute pressure as before	0·94
Vapour pressure	0·69
Air pressure absolute..	0·25

and the volume occupied by 1 lb. of air would be—

$$Va = \frac{13{\cdot}14 \times 14{\cdot}7}{0{\cdot}44} \times \frac{T + 90^\circ\text{ F}}{T + 60^\circ\text{ F}} = 820 \text{ cub. ft. per lb.} \qquad \text{(B)}$$

If the same air pump be used, the total air exhausted per hour would only be—

$$\frac{455}{820} \times 100 = 55\tfrac{1}{2} \text{ per cent. of (A)}$$

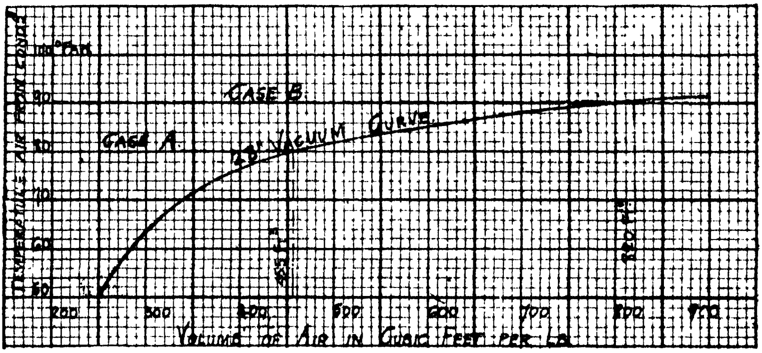


FIG. 1.

The curve shown in figure 1 illustrates the variation in volume of 1 lb. of air at 28 in. vacuum with variation in temperature of the mixture reaching the air pump, the point at *A* illustrating the first example and *B* the second case.

A case which came to the writer's notice showed that these simple considerations had not been given due weight. A size of dry air pump which had been very successful in one sugar factory was sold to a neighbouring plant of similar size and output. No difficulties were, therefore, expected, but as the vacuum was low the case had to be investigated. It was found that in the first factory the temperature of the water was about 75° F, whilst in the second the temperature varied from 90° to 100° F. The condensers were in each case existing, and of the parallel flow type, as shown in figure 2, each vacuum pan and evaporator having its own separate condenser. There were five small condensers in each plant, and the air connexions were made as shown through a small isolating valve, and were led to a water separator before reaching the air pump. The drain from this separator fell away through a barometric column.

In the first case, a vacuum of 27 in. was steadily maintained, whilst in the second a vacuum of 22 in. to 23in. was usual. The factory engineers blamed the air pump, particularly the inlet valves, but the real reason was the high temperature of the air going to the air pump, as will be shown.

In case 1 the air temperature was 100° F, for which at 27 in. vacuum the volume of 1 lb. of air is 425 cub. ft. In case 2 the temperature of air was 140° F, for which the volume at 23 in. vacuum is also 425 cub. ft. It will, therefore, be noted that if the two pumps had the same volumetric efficiency, they would each be dealing with exactly the same amount of air per hour, in spite of the fact that the vacuum was so much better in the first than in the second case. The air pump could not, therefore, be blamed for the low vacuum.

If, however, the air separator previously mentioned had been fitted with a small injection of water to cool the mixture to about 100° F, the air pump would have been dealing with air at the same density, and would have provided practically the same vacuum as in the first factory, and the plant would have been satisfactory.

It is commonly assumed that a "dry" air pump deals with dry air only. This is not so, however, and the amount of watery vapour contained in the mixture reaching the pump can be found in the same manner as the volume of the air.

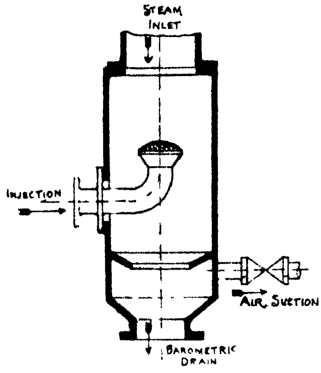


FIG. 2.

Taking the case of 28 in. vacuum and 80° F as temperature of mixture at the air pump, we found that the volume occupied by 1 lb. of air was 455 cub. ft. This volume is not all air, but contains vapour according to the vapour pressure corresponding to 80° F, which is 0·5 lbs. per sq. in. At this pressure 1 lb. of steam occupies 633 cub. ft. (*see* steam tables), so that in 455 cub. ft. there is 0·715 lb. of vapour. There is, therefore, nearly ¾ lb. of vapour drawn into the pump with every lb. of air at this temperature. At 90° F the amount of vapour per lb. of air would be 1·75 lbs., and so on up to 100° F, corresponding to the vacuum, at which temperature the amount of steam per lb. of air would be infinite, and could not be dealt with in any practical air pump of the displacement type.

The relative functions of the condenser and air pump are, therefore, clearly defined. The condenser produces a temperature at which it is possible to attain the desired vacuum, with an air pump of reasonable size, and the air pump must be capable of removing the air at the said temperature.

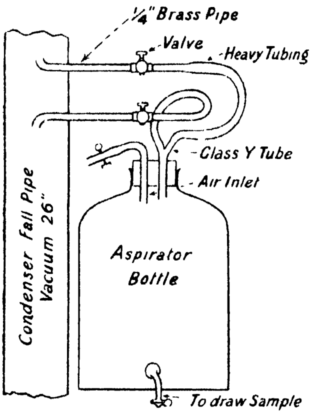
The Royal Commission on the Sugar Supply have arranged to grant a quantity of sugar, in all not to exceed 60 tons, for the purpose of feeding bees in the United Kingdom. Such sugar will only be available in the form of bee candy, and its manufacture and sale have been undertaken for the Departments concerned by Messrs. SYDNEY PASCALL & SONS, LIMITED, Blackfriars, London.

The Quantitative Determination of Minute Amounts of Sugar by Alpha-Naphthol and the Estimation of Entrainment Losses.

By A. F. BLAKE,

Chief Chemist, Atlantic Sugar Refineries Limited, St. John, N.B., Canada.

The application of the α-naphthol reaction to the quantitative determination of minute amounts of sugar in water appears to have received attention recently from a number of independent experimentists. An adaptation of the usual qualitative procedure to quantitative work is described by D. W. ROCKEY.[1] In the October number of this Journal, H. PELLET[2] describes an entirely different and much improved method. It is interesting to note that this latter procedure is quite similar to one, independently developed, which has been in use, and with marked success, in this laboratory for some time. The technique of this test was worked out in a refinery in the United States, but the system of colour standards (and herein lies the principal difference from Pellet's method) originated with us here.



The test is performed in a shell-glass vial, such as is commonly used for rack samples of liquors. The same size vials should always be used, and should be about the dimensions of ours, viz., 30 mm. diam. by 59 mm. high, with straight sides. 5 c.c. of the solution to be tested, measured by means of a small graduate, is placed in the vial; 5 drops of a 20 per cent. solution of α-naphthol in pure ethyl alcohol are added from a dropping bottle, and then 10 c.c. of concentrated sulphuric acid are carefully introduced. The mixture, which becomes very hot, is immediately stirred vigorously with a glass rod. In the presence of sugar a purple-red colour develops throughout the solution, and the intensity of colour is proportional to the amount of sugar present. After two minutes the colour of the solution in the vial is compared with that of standard colour solutions contained in identical vials, the preparation of which is described later.

The vials and rods must be scrupulously clean. To insure this, they should be washed, rinsed in distilled water, and allowed to drain under cover. Wiping with a towel is absolutely fatal to the test. A supply of clean vials is always kept in readiness. It is not necessary to measure the solution or the sulphuric acid with pipettes, small, narrow graduates being sufficiently accurate and much more convenient. When running a number of tests at once, the graduate for the solution is rinsed four times with each solution before filling. The α-naphthol, when kept in a small dropping bottle, is well protected and at the same time ready for instant use. It becomes dark brown on standing, but this does not appear to alter the results. It is made up fresh once a week. The standard amount, 5 drops of a 20 per cent. solution, is always added. This is undoubtedly a large excess, but does no harm and insures a sufficiency at all times. The colour produced increases perceptibly for some time after its formation, and thus the definite interval of time before matching against the standards must be observed.

---

[1] *I.S.J.*, 1916, 139.

[2] *I.S.J.*, 1916, 466.

Thus far the method differs from Pellet's only in the quantity and the relative proportions of the solutions used. The essential difference is in the colour standards. PELLET uses a coloured diagram, whereas we keep permanent coloured solutions in vials the same as those used in the test, well stoppered and sealed for protection. The results of the test are expressed in parts of sugar per million of solution. The standards are made to represent the following values:—1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 15, 20, 30, 40, 50, 60, 80, and 100 parts per million. The colour produced in the test by less than 20 parts of sugar per million can be exactly duplicated by mixing solutions of cobaltic nitrate and copper sulphate in proper proportion and concentration. For the standards above 20, we have not as yet discovered any suitable inorganic colours, and the two salts mentioned above will not give the proper shade. The addition of permanganate to these is capable of producing the desired colours, but the standards so made last but a few hours. We have therefore been obliged to use a mixture of red and blue coal-tar dyes for these higher standards, which give precisely the correct colours, but gradually change with time and must be renewed about once a month for accurate work. The inorganic standards are permanent. The standards are made much more easily and expeditiously than would be supposed. A solution containing the required amount of sugar, made by weighing out pure sugar, dissolving in a definite volume, and systematically diluting, is treated by the prescribed method, and the colour after two minutes' standing is used as a basis for that of the standard. The standard is checked by two or three tests. Any gross error is easily detected by the eye.

The method cannot be used directly for quantities of sugar over 100 parts per million. By diluting the solution with a definite volume of distilled water, then testing, and correcting the results by proportion, the test may still be used. If the sugar content is much over 100 parts per million, however, it may be determined by the polariscope, the solution being read directly in the 200 mm. tube. Each 0·05° may be regarded as 125 parts per million. This would be exactly the case if the specific gravity were $\frac{26 \times \cdot 05 \times 100}{125} = 1\cdot 04$, and in any case is more accurate than the reading of the instrument.

The error involved in developing and matching the colours in this test appears to be about 20 per cent. In pure sugar solutions the actual quantity may therefore be determined with this accuracy. In water containing sugar from low test material, such as would be entrained from evaporators, it is a little difficult to determine exactly what the results represent, the invert sugar and some of the organic matter giving the colour reaction as well as sucrose, but the error involved is not of great moment. The presence of iron in the solution tested interferes somewhat by producing a coloration of its own, modifying the shade to make matching with the standards uncertain. If the solution contains the products of the destructive distillation of low grade material, the test is quite worthless. We have noted white precipitates and yellow, green and orange colorations. This condition is fortunately rare. With the salt water from condensers the test has given perfect satisfaction.

The test as described is as quick and more certain than the usual qualitative one, and hence has entirely taken its place here. Besides its qualitative value for detecting sugar where it ought not to be, as in the condensation from heating coils, it is of great service in measuring the amount of entrainment in pans and evaporators. A very little entrainment is unavoidable, and traces of sugar are therefore nearly always discovered in condenser water by a good qualitative test.

The quantitative test is necessary to ascertain whether the losses are excessive, and, if so, to demonstrate the effectiveness of whatever may be done to effect a cure. Entrainment from pans should be only 2 or 3 parts per million in condenser water, and from evaporators not over 10 or 15.

To estimate entrainment losses, a continuous day and night sample of condenser water may be taken. This is done in spite of the vacuum by a device shown in the sketch. The bottle is as large as possible to permit sampling to be continued all night without filling. After determining the sugar in this water, it is only necessary to know the quantity of salt water per hour in order to estimate the entrainment. This may be found occasionally by observing the salt water temperatures before and after entering the condenser and applying the table published in *The Journal of Industrial and Engineering Chemistry*, October, 1910, which also appears in the latest edition of Spencer's *Handbook for Cane Sugar Manufacturers*, which gives the pounds of condenser water from 1 lb. of water evaporated. The latter may be easily determined by a simple capacity test. In this fashion we have determined regularly our total monthly loss from evaporator entrainment.

Fuel Value of Bagasse.

An Engineer's Notes.

The effect of poor crushing on the steam-generating power of the boiler-house, due to a high percentage of moisture content, is not generally understood as well as it might be.

The following figures will clearly show the benefits to be derived from a reduction in moisture. Taking the waste gases at 500°F, excess air at 100 per cent. and 84°F, the nett thermal value of bagasse per lb. after all allowances for chimney losses, leakages. and radiation have been accounted for, will be as follows:—

Per cent. Water.	Nett value of Green Bagasse in B Th. Units.
44	2683
45	2610
46	2551
47	2484
48	2412
49	2349
50	2286

It will be seen that a reduction from 50 per cent moisture content to 46 per cent. will mean quite 10 per cent. less fuel.

All surplus bagasse should, therefore, be left as long as possible before using, and thus in time becomes very easily worth 25 per cent. more as a fuel than the green bagasse from the mill.

Experiments have recently been made upon the fertilizing value of sodium-ammonium sulphate as compared with ammonium sulphate. Owing to the scarcity of sulphuric acid, sodium bisulphate (nitre-cake) is being used to a large extent to absorb ammonia. The material with which the experiments were made contained 9 to 10 per cent. nitrogen and the crops treated were rye, oats, barley, and several varieties of beets and cabbage. In every case, ammonium and sodium-ammonium sulphates gave practically the same yields when equivalent amounts of nitrogen were applied.

France.

Results of the Sugar Beet Campaign of 1915-16.[1]

Official data of the beet campaign of 1915-16 in France have recently been issued by the French administration. According to the particulars thus supplied, the number of beet sugar factories at work during the season under review was only 64 as compared with 69 in the previous year, and 206 just before the war broke out. For obvious reasons work has been exceptionally difficult and tedious, and the average run of the campaign per factory did not exceed 48·5 days of 24 hours.

The acreage under roots is variously stated, but while the Ministry of Agriculture puts it at 77,506 hectares (as compared with 84,318 hectares in 1914-15) the returns of the sugar factories themselves (as well as of the Ministry of Finances) place the total at a lower figure. The more generally accepted estimation under present advices gives us 64,955 hectares (160,440 acres) as having been under cultivation, as compared with 59,209 hectares in the previous season and 213,350 hectares (526,975 acres) at the outbreak of the war. Provisionally the quantity of roots harvested from this area is placed at 1,150,000 metric tons, which corresponds roughly to a yield of 19 tons per hectare (7¾ tons per acre) as compared with 26·7 tons per hectare (10¾ tons per acre) in 1914.

Subject to final corrections when statistical information is more complete, the following figures of production can be given as approximately correct.

Campaign.	Factories in operation.	Production, expressed as Refined, Metric Tons.	Yield in Sugar, Per cent. Beets.
1901-02	332	1,051,930	11·25
1911-12	220	465,395	11·41
1912-13	213	877,656	13·30
1913-14	206	717,400	12·08
1914-15	69	302,960	11·50
1915-16	64	135,899	11·74

The drop in the number of factories working as compared with those existing in 1884 is a noteworthy feature. At the outbreak of the war there were only 206 establishments in the whole of France, as compared with 483 when the so-called Law of 1884 was instituted. This law, which imposed an excise duty on beetroots, undoubtedly hastened the disappearance of those establishments which were unable to keep abreast of the times and maintain the struggle for existence; but it gave substantial encouragement to the cultivation of a beet rich in sugar and ensured the prosperity of those firms whose factories were fitted with modern plant and were skilfully supervised. Concentration of labour, improvement in the raw material, increase in the degree of extraction, a considerable reduction in the cost price of the sugar turned out—such were the consequences of the new régime. In 1914 came the war and destroyed at least temporarily all this progress; and at the present moment the cost of production is more than double what it was before the outbreak of war.

The price of raw sugar was quoted for the last time on the Paris Bourse on December 18th, 1915 (when frs. 82 for No. 3 was asked), while two days later the last quotation for refined loaves was frs. 109 to 109·50. A month later a ministerial Decree was promulgated, instituting an official commission to evaluate the existing stocks of sugar and control all prices. On March 8th it was announced that quotations for white sugar No. 3 and raw 88° were to be reopened on the Bourse. With April 20th came fresh taxes on sugar and other articles. In May a decree fixed the maximum wholesale prices of sugar as follows: Crystallized, frs. 78·60; loaf sugar (including the duty of 25 frs.), frs. 118; refined, including "ranged" tablets, frs. 121·50. Moreover, in the Department of the Seine, a police ordinance fixed the maximum retail prices to be observed by the vendors.

---

[1] Abridged from the *Journal des Fabricants de Sucre.*

The consumption in France for the 1915-16 season was considerably less than in the previous year, amounting to 563,479 tons as compared with 638,638 tons in 1914-15.

Imports of sugar increased from 366,861 to 532,721 tons; on the other hand, the exports rose also from 94,147 tons in 1914-15 to 134,975 tons in 1915-16.

The Cuban Sugar Crop.

PAST SEASON'S TOTAL AND PRESENT SEASON'S ESTIMATES.

Messrs. Guma & Mejer's figures of the past and prospective Cuban crops are set forth below, the totals being of the different provinces.

	1915-16 Total		1916-17 Estimate.	
	Centrals	Sacks.*	Centrals	Sacks.
Habana	21	1,617,805	23	1,956,000
Matanzas	29	3,380,395	30	3,724,000
Cárdenas	20	2,787,899	19	2,912,000
Cienfuegos	25	2,688,095	25	3,036,000
Sagua	21	1,562,388	19	1,649,000
Caibarién	15	1,367,015	16	1,560,000
Guantánamo	11	616,705	12	870,000
Cuba	5	345,458	7	680,000
Manzanillo	9	814,999	9	925,000
Santa Cruz del Sur	1	306,500	1	375,000
Nuevitas	2	393,499	3	480,000
Antilla	14	1,372,485	19	2,105,000
Nipe Bay	1	385,526	1	440,000
Júcaro	5	1,066,391	8	1,410,000
Gibara y Puerto Padre	4	1,882,038	3	1,550,000
Banes	—	—	2	619,000
Manatí	1	297,695	1	500,000
Zaza	2	85,353	2	107,000
Trinidad	1	85,877	1	110,000
	187	21,055,403	201	25,008,000
	Equal to 3,007,915 tons.		Equal to 3,572,571 tons.	

As regards individual factory outputs the first six places are held by Chaparra with 87,636 tons, Central Boston with 73,370 tons, Stewart with 69,864 tons, Delicias with 61,452, Central Nipe with 55,075, and Gómez Mena with 50,000 tons.

---

*7 sacks equal 1 ton.

A Simplified Inversion Process for the Determination of Sucrose by Double Polarization.[1]

By HERBERT S. WALKER.

Probably the greatest drawback to the use of "true sucrose" determinations in sugar factory control work has been the necessity for such extreme care in the regulation of time and temperature required by the Herzfeld-Clerget inversion process. So sensitive to faulty manipulation is the method ordinarily used that an inexperienced chemist may get even less accurate results by double polarization than by simply assuming the direct polarization to represent the "true sucrose."

To avoid any decomposition of levulose during inversion, TOLMAN[2] suggested inverting at ordinary laboratory temperatures. This method has never been largely adopted in cane sugar factories, owing to the fact that at least ten hours are required for the complete inversion of the half-normal weight of pure sucrose in 50 c.c., and probably a considerably longer time would be needed where organic impurities are present, as in the case of waste molasses.

STEUERWALD[3] has also proposed inverting in the cold, and shortens the time required to two or three hours by using three times the usual quantity of acid (30 c.c. of a mixture of equal parts concentrated hydrochloric acid and water). The convenience of using a diluted acid will be appreciated by anyone who has had to measure many successive portions of concentrated hydrochloric acid with the same pipette. Steuerwald's method, however, as pointed out by PELLET[4] when dealing with impure cane or beet products, accentuates the error inherent in the Herzfeld-Clerget process, in that optically active substances other than sucrose may, in a strongly acid medium, have a quite different rotation from that indicated in a neutral or slightly acid solution used for direct polarization.

The writer has for some time held the idea that for rapid work in a sugar factory a compromise between these methods might be advantageously employed, namely, heating the sugar solution to some definite temperature before adding acid and letting it cool down slowly in air during a time sufficient for the inversion to become completed. The only attention required would be to control the temperature of the solution at the moment of adding the acid. Since the preliminary heating would be in neutral solution, the time required to raise to a definite temperature would be immaterial. Aside from its convenience of manipulation, such a method should, theoretically, possess the advantage over the Herzfeld procedure of being less subject to error due to destruction of levulose, since the maximum temperature of the solution would coincide with the minimum amount of invert sugar present, and at the time of nearly complete inversion the temperature would have dropped to such a point that there would no longer be any danger from this source.

In working out this method, 15 minutes was chosen as a convenient time for the duration of inversion. To avoid if possible any great change in the inversion constant, the same concentrations of sugar and acid were used as in the Herzfeld method.

Experiment 1.

Approximately 130 grms. of "Crystal Domino" sugar were dissolved in 500 c.c. of water, this solution giving a direct polarization of 99·66. 50 c.c.

---

[1] Presented at the annual meeting of the Hawaiian Chemists' Association, Oct. 12th, 1916.

[2] Bull. 73, *U.S. Bur. Chem.*, page 69. [3] *Archief*, 1913, 831; *I.S.J.*, 1913, 489.

[4] *I.S.J*, 1916, 83.

portions of this solution were pipetted into 100 c.c. flasks, 25 c.c. of water were added, and the flasks heated in a water-bath to certain different temperatures. After adding 10 c.c. of a mixture of equal volumes of concentrated HCl and water, the liquid was allowed to stand 15 minutes in air, cooled down to room temperature in water, made up to 100 c.c., and polarized. A parallel test was made at the same time, using the Herzfeld procedure.

Calculating the percentage of sucrose, and using the same direct polarization and the constant 144·66 — 0·5*t* for all, the following results were found:—

Herzfeld.	New Method.			
	Temperature at which acid was added.			
	77°	75°	73°	71°
99·93	99·81	99 65	99·71	99·83

All tests by the new method yielded lower results than by the Herzfeld. To determine whether this was due to incomplete inversion in 15 minutes, or to too high or too low initial temperatures, a similar experiment was carried out at lower temperatures, letting the solutions stand in air for 30 minutes after adding acid.

Experiment 2.

Using a direct polarization of 99·61, the values for the sucrose were:—

	Herzfeld.		New Method.			
			Temperature at which acid was added.			
	1	2	72°	70°	68°	64°
	99 91	99·86	99·86	99·81	99·90	99·89
Average 99·89						
Difference from Herzfeld..			—0·03	—0·08	—0·01	—0·00

With initial temperatures between 72° and 64°, the results obtained are fairly constant among themselves and agree well with those obtained by the Herzfeld method.

Experiment 3.

Using a direct polarization of 99·50, the values for the sucrose were:—

	Herzfeld.		New Method.				
			Temperature at which acid was added.				
	1	2	64°	60°	56°	52°	48°
	99·89	99·8	99 92	99·91	99·83	99·22	97·10
Average 99·85							
Difference from Herzfeld..			+ 0·07	+ 0·06	—0 02	—0 63	—2·75

With a lower initial temperature than 56°, inversion is not complete in 30 minutes.

Experiment 4.

Here the time of inversion was diminished to 15 minutes, the direct polarization was 99·62, giving a sucrose content of:—

	Herzfeld.		New Method.				
			Temperature at which acid was added.				
	1	2	70°	67°	65°	63°	59°
	99·89	99·99	99 93	100·03	100·03	100·00	99 93
Average 99·94							
Difference from Herzfeld..			—0·01	+ 0·09	+ 0·09	+ 0·06	—0·01

The surprising fact brought out by these tests is the comparatively great latitude of the method. Whereas the Herzfeld procedure requires a rigid adherence to 69°, and a definite time of heating, this method, with initial temperatures anywhere between 59° and 70°, yields concordant results which agree with those obtained by the Herzfeld method as closely as the latter do with each other. It also appears that 15 minutes is ample time for inversion, and that standing for 15 minutes longer has no effect on the results. With a laboratory temperature of 26° the solutions were found to drop from 70° to 46°, and from 60° to 41° on standing in air for 30 minutes, so it is extremely improbable that any further destruction of levulose would take place, even if the inverted solutions were allowed to stand several hours longer.

Having obtained such satisfactory results from pure sugar, several experiments were next made to see if the method would work equally well with molasses. A large sample of molasses was clarified according to the method of the Hawaiian Chemists' Association, and inverted by the Herzfeld and by the new methods.

Experiment 5.

71·50 grms. of waste molasses dissolved in water, were clarified with 80 c.c. of basic lead acetate, made up to 500 c.c., and filtered. For the direct polarization, 50 c.c. filtrate were treated with 1 c.c. of saturated aluminium sulphate solution, made to 55 c c., filtered and polarized. Reading × 2 = direct polarization. 75 c.c. of the first filtrate were inverted, cooled, made up to 100 c.c., decolorized with a slight excess of zinc dust, filtered, and polarized in a 400 mm. tube. Reading $\times \frac{4}{3} \times \frac{10}{11}$ = invert polarization. Factor = 142. The sucrose calculated from the Herzfeld and new inversion methods using a direct polarization of 27·90 was:—

	Herzfeld.	New Method. (15-minute inversion.) Temperature at which acid was added.				
		77°	75°	73°	71°	69°
	34·69	34·17	33·28	32·82	33·05	34·16
Difference from Herzfeld...		—0·52	—1·41	—1·87	—1·64	—0·53

Since all these results were much lower than those obtained by the Herzfeld method, 30 mins. standing and a lower initial temperature were next tried.

Experiment 6.

Using a direct polarization of 27·66, the sucrose values were:—

	Herzfeld.	New Method. (30-minute inversion.) Temperature at which acid was added					
		67°	65°	63°	61°	59°	57°
	34·51	34·33	34·29	34 10	34·09	34·04	33·16
Difference from Herzfeld...		—0·18	—0·22	—0·41	—0·42	—0·47	—1·35

While an improvement over those obtained in the preceding test, these results were still rather low and irregular. It was thought that the excess of basic lead acetate in solution might have had a destructive effect on the levulose already present in the molasses during the heating prior to adding acid. To determine if this were the case, the next experiment was performed in duplicate, one of which was manipulated as before, and the other treated with 1 c.c. of 1 to 1 hydrochloric acid (this being approximately the amount of acid necessary to neutralize the alkalinity due to basic lead acetate) before heating.

Experiment 7.

Using a direct polarization of 27·60, the sucrose values were:—

Herzfeld.	Herzfeld.	New Method. Temperature at which acid was added.			
		69°	67°	69°	67°
5·5 c.c. HCl.	5 c.c. HCl.	1 c.c. acid added before heating.		No acid added before heating.	
34·41	34·30	34·45	34·52	33·30	33·10

It is quite evident that a serious loss occurs if the solution of molasses clarified with excess of basic lead acetate be heated before adding acid, while if the alkalinity be neutralized prior to heating all irregularities seem to disappear.

Further tests were made to determine the permissible limit of initial temperature. In all the following experiments the solutions to be inverted were first neutralized with 1 c.c. of 1 to 1 hydrochloric acid.

Experiment 8.

Using a direct polarization of 27·44, the sucrose values were:—

Herzfeld.		New Method. (30-minute inversion.) Temperature at which acid was added.				
1	2	72°	70°	68°	66°	64°
34·33	34·34	34·32	34·39	34·34	34·39	34·37
Average 34·34						
Difference from Herzfeld...		—0·02	+0·05	0·00	+0·05	+0·03

The next test covers a still greater range of temperature.

Experiment 9.

Using a direct polarization of 27·40, the sucrose values were:—

Herzfeld.		New Method. (30-minute inversion.) Temperature at which acid was added.				
1	2	70°	64°	60°	58°	56°
34·51	34·58	34·59	34·59	34·61	34·41	34·01
Average 34·54						
Difference from Herzfeld...		+0·05	+0·05	+0·07	—0·13	—0·53

Having found initial temperatures between 70° and 60° to yield satisfactory results on 30 mins. standing, a final test was made to cover this range with an inversion period of only 15 mins.

Experiment 10.

Using a direct polarization of 27·58, the sucrose values were:—

Herzfeld.		New Method. (15-minute inversion.) Temperature at which acid was added.				
1	2	70°	67°	65°	63°	60°
34·54	34·54	34·61	34·61	34·63	34·59	34·43
Average 34·52						
Difference from Herzfeld...		+0·09	+0·09	+0·12	+0·07	—0·09

Hence, the safe limit of initial temperatures for waste molasses appears to lie between 70° and 63° for a 15-minute inversion period.

The modified inversion method proposed, based on the above experimental evidence, is as follows:—Place 50 c.c. or 75 c.c. of the solution used for direct polarization in a 100 c.c. flask (if 50 c.c. are used, add 25 c.c. water) and heat in a water-bath to 65° C. Remove from bath, add 10 c.c. of a mixture of equal volumes hydrochloric acid (sp. gr., 1·188) and water, allow to cool down spontaneously in air for 15 mins. or as much longer as may be convenient, cool in water to room temperature, make up to 100 c.c., and polarize as usual. In the case of low-grade products, which have been clarified with a large excess of basic lead acetate, it is imperative that the excess alkalinity be neutralized before heating, this being best accomplished by the addition of 1 c.c. (or 2 c.c. in exceptional cases where a large excess of dry lead has been used) of the dilute acid used for inversion.

When a considerable number of determinations are to be made at the same time, the writer uses for a water-bath a flat-bottomed iron pan accommodating a dozen or more flasks and containing only enough water to be above the surface of the liquid in the flasks. The whole is heated to about 70°, and the flame turned out; when a thermometer in one of the flasks indicates 67°, the flasks are taken out one at a time, acid added and the whole set aside for inversion.

From a scientific standpoint this inversion process may be criticized on account of the fact that, due to variations in laboratory temperature and in thickness of flasks, marked differences in the rate of cooling, and hence in the speed of inversion, may occur. Practically, no difference outside the experimental error could be detected, even when the temperatures at which acid was added varied as much as 10°. It may be also that the constant required for this method will be found on careful investigation to vary slightly from that now used in the Herzfeld method, which is itself under suspicion. In the above work no attempt has been made at much greater accuracy than what might be expected in a well-equipped factory laboratory, and within these limits the method has been found fully as accurate as that of Herzfeld, and much more convenient.

DEPARTMENT OF SUGAR TECHNOLOGY,
COLLEGE OF HAWAII.

The Composition of Precipitates obtained from Syrups in White Sugar Manufacture.

By H. PELLET.

Messrs. C. E. COATES and L. C. SLATER[1] have examined the precipitates obtained from two syrups made in two sugar factories in Louisiana. The first syrup originated from juice which had been treated by sulphurous acid and then by lime, heated, passed through a sand-filter, and concentrated to 53° Brix, giving after some time a gelatinous precipitate, which had been washed, dried, calcined, and analysed.

The second precipitate came from a juice which likewise had been sulphited and limed, passed through bags, treated with phosphoric acid, concentrated, brought to boiling, and the syrup lastly passed through a battery of inclined separators. A precipitate left in these separators had been collected, washed, dried, calcined, and analysed from the point of view of the mineral composition of the residue. Messrs. COATES and SLATER gave the composition of these two calcined deposits as follows:—

	Factory No 1	Factory No. 2
Silica	75·3	53·7
Iron, alumina, and calcium phosphate	5·3	34·5
Lime	8·3	4·1
Copper	11·3	1·2
Phosphoric acid	0·6	13·5
Sulphuric acid	4·0	nil.

These authors add a note stating that the dried precipitate from Factory No. 1 contained 58 per cent. of ash and 42 per cent. of organic matter, and that from Factory No. 2, 75·6 and 24·4 per cent. respectively.

They explain the greater quantity of silica in the deposit from Factory No. 1 to be due to its filtration over sand. This is by no means our opinion. Generally one chooses a sand quite unattackable by cane juice, and we consider that this silica came solely from the juice itself. In fact cane juice contains silica in proportions that are sometimes quite considerable, and this silica, which is in the form of alkali silicates and in the colloidal state, is not precipitated by the ordinary treatment which the juice undergoes, that is to say, sulphitation and liming, or inversely, liming and sulphitation. The quantity of silica eliminated by this treatment is variable, and depends precisely upon the amount originally present and upon the degree of acidity or of alkalinity. Only a very slight difference in the reaction of the juice is necessary to determine whether the silica is more or less well precipitated.

---

[1] *I.S.J.*, 1916, 573.

Then the juice itself during concentration gradually loses its alkalinity, so that a juice slightly alkaline, for example, may give a syrup neutral or slightly acid; a juice that is neutral, a syrup appreciably acid; and lastly a juice distinctly acid a syrup the acidity of which has increased.

Now when a liquid containing silica in solution owing to a certain alkalinity gradually loses this alkalinity, the silica is slowly deposited in the gelatinous state. This precipitation of silica may be observed after the concentration of juice which has not at all been filtered over sand. It may be verified by analysing the deposits in different bodies of evaporators, and we have had occasion to publish several notes on the subject.

Referring to the precipitate from Factory No. 2, it is not astonishing to notice the presence of a considerable quantity of phosphoric acid, since the juice itself had been treated with this reagent. It would seem that this phosphoric acid treatment had not been done in a rational manner, and that there had been a re-solution of the calcium phosphate for some reason impossible to determine or suppose. But this calcium phosphate soluble in the sugar juice is also precipitated on concentration, since it is known by experience that even in *sucreries* in which phosphoric acid is not used, the sulphated and limed juice contains enough phosphate for this constituent to be deposited gradually during concentration with the silica, while other substances, such as oxalic acid, remain in solution in spite of the ordinary preliminary treatment of sulphitation and liming. It is thus that the deposits in evaporating apparatus present in the case of cane juice an extremely variable composition, depending upon the number of the vessel, the nature of the juice, and the treatment which it has undergone.

Another observation may be made. It is quite evident that at first sight the precipitate from Factory No. 1 contains more silica than that from the other; but the composition of the precipitate from Factory No. 2 is totally modified by the presence of a considerable quantity of calcium phosphate, which reduces the centesimal content of the silica. If, therefore, one eliminates the difference between 34·5 and 5·3, i.e., 29·2 per cent., comprising the iron, alumina, and calcium phosphate of both precipitates, 53·7 of silica for 70·8 of calcined matter is obtained, giving 75·8 of silica against 75·3 in the ash of the precipitate from Factory No. 1. In a word, we believe (and indeed are almost certain) that if the juice from Factory No. 2 had also been filtered over sand, the precipitate obtained would not have contained more silica than the amount indicated in the analysis published.

It is worthy of remark that the treatment followed by Factory No. 1 for clarification would seem to be rather defective, since the deposit contains as much as 11·3 per cent. of copper which could only come from the apparatus, this indicating an appreciable deterioration.

A rather serious outbreak of fire took place at the engineering works of Messrs. JOHN McNEIL & Co. LTD., Glasgow, at the end of December, the pattern shop being the scene of the damage. Fortunately not all of the patterns were destroyed and as the drawings are intact, we understand the firm will not be put to any serious trouble on account of damaged stock.

Messrs. WILLETT & GRAY conclude that the exports of American refined and Cuban raws during 1917 will not exceed the figures of 1916, 619,000 tons of refined and 735,000 tons of Cubas, but if anything should be rather less. Taking into account this possibility of reduced shipment abroad, together with the increase in crops, they consider that prices should approximately range between 3½ c. and 4¾ c., c. and f., during 1917.

Methods of Chemical Control for Cane Sugar Factories.[1]

Compiled by the Committee on Revision of Methods and adopted by the Hawaiian Chemists' Association, October 22nd, 1915.

SYRUP.

Sucrose.—From each sample of syrup collected during the day a small subsample is put aside for the determination of sucrose once in 24 hours. It is best to take the direct as well as the invert reading of this sample.

A normal weight of the syrup is transferred to a 100 c.c. flask with the aid of a little water; from 3 to 5 c.c. of basic lead acetate solution are added, the liquid filled to the mark with water, shaken, filtered, and polarized in a 200 mm. tube, noting the temperature of the solution. The reading gives the direct polarization.

Place 50 c.c. of the filtrate in a 100 c.c. flask, add about 25 c.c. of water, and proceed as described under sucrose in mill juices.[2] Make up to 100 c.c., and polarize in a 200 mm. water-jacketed tube, at the same temperature at which the direct reading was made. The sucrose is found from the formula: $\frac{100(D-2I)}{142{\cdot}3-0{\cdot}5t}$, in which D = direct polarization, I = invert reading, and t = temperature of observation in Centigrade degrees.

Glucose.—If it is desired to determine the glucose, the subsample taken for the determination of sucrose should be used. Dilute the same as for the Brix determination, and proceed the same way as under "mill juices."[3]

MASSECUITES.

Sampling.—Take a large sample of massecuite as it is leaving the pan, from the first, middle, and last part of each strike, mix well, and take a subsample to the laboratory, where it can either be analysed at once, or composite examples can be made up from each grade, and analysed once a week. Massecuites can be kept without a preservative for several days in a closed container without deterioration.

Analysis.—A diluted sample is prepared by the method[4] described under "Syrup," of from 15° to 20° Brix, the Brix and polarization determined and calculated back to the original. Great care must be taken that all the grain is dissolved in diluting.

MOLASSES.

The first and second molasses as they come from the centrifugals are seldom analysed any further than for apparent purity and Brix. The methods followed are the same as those described for massecuites. It may be noted here that in case the purity alone is wanted, and not the Brix, an approximate mixture of 15° Brix is sufficient, and no weighing need be done.

COMMERCIAL SUGAR.

Sampling.—The sample is best taken automatically, where this can be arranged, so that there will be no evaporation. Otherwise, a pinch should be taken from every few bags as they are weighed, and placed in a covered bucket with a small hole in the top.

Empty the content of the sample bucket upon a large sheet of heavy glass plate or other non-absorbent material (as glazed porcelain), remove any foreign matter, and mix rapidly. Crush any lumps, and thoroughly incorporate with the rest of the sugar. Weigh out for analysis at once.

---

[1] The previous instalments appeared in the 1916 volume of this Journal, pp. 468-72, 513-17 and 553-56.

[2] 1916, 554.

[3] 1916, 555.

[4] 1916, 556.

Total Solids.—About 2 grms. of sugar are weighed on one of a set of double watch-glasses, made to fit together tightly with a clamp, and heated in an oven at 100° to 105°C. for three hours, the watch-glasses being then placed together, cooled in a desiccator, and weighed. From the loss in weight the per cent. moisture is calculated, and 100 — per cent. moisture = total solids.

Brix.—Weigh out 500 grms. of sugar, add 500 grms. of water, and stir until the sugar is completely dissolved. Remove the air *in vacuo*, determine the Brix of the solution, and multiply the result by 2 for the Brix of the sugar.

Polarization.—A normal weight of sugar is dissolved in water in a 100 c.c. flask, from 1-2 c.c. of lead solution added, and the liquid made up to the mark. The filtrate is polarized in a 200 mm. tube. (On account of differences in temperature, the polarizations of commercial sugar read about 0·3° higher in New York and 0·2° higher at San Francisco than in Hawaii.)

Sucrose.—To 50 c.c. of the filtrate obtained as above mixed with 25 c.c. of water in a 100 c.c. flask, 5 c.c. of conc. hydrochloric acid are added and the inversion carried out as for syrup, the reading being made in a 200 mm. tube. The percentage of sucrose is calculated by the following formula :—

$$\text{Per cent. sucrose} = \frac{100\,(D - 2\,I)}{142{\cdot}6 - 0{\cdot}5t}$$

in which the letters have the same significance as under "Syrup," above.

FINAL MOLASSES.

Sampling.—Take an aliquot quantity of final molasses from each weighing or measuring tank, and keep in a closed container until the end of the week.

Brix.—The average sample of final molasses must be diluted to about the average Brix of the mixed juice, and after the removal of the air, the Brix is determined as described under "Syrup." Care must be taken that no grains of sugar are left undissolved.

Insoluble Solids.—Weigh about 5 grms. of the thoroughly mixed sample of molasses in a sugar dish, wash into a 500 c.c. flask, make up to the mark, and mix thoroughly. Measure out 100 c.c. of the solution with a pipette, and pass through a Gooch crucible with asbestos pad which has been previously dried and weighed. Wash four or five times with distilled water, dry at 100° to 105° C for two hours, and weigh.

Total Solids.—About 15 grms. of medium fine silica sand that has been washed with hydrochloric acid, or half that weight of coarsely powdered pumice stone, are placed in a shallow dish with a short stirring rod, and heated for an hour at 100° to 105° C. After cooling in a desiccator, and weighing, about 3 grms. of molasses are weighed into the dish, about 1 c.c. of hot water added, and the liquid thoroughly mixed with the sand. It is now heated, preferably in a vacuum oven at 75° C., or in an air bath at 100-105°C. for five hours, cooled in a desiccator, and weighed. The weight found, *minus* the weight of the dish *plus* sand, equals the weight of total solids.

Polarization and Sucrose.—Dissolve 35·75 grms. of molasses in water, add 40c.c. of basic lead acetate solution, make up to 250 c.c. with water and filter. To 50c.c. of the filtrate add 1 c.c. of a saturated solution of aluminium sulphate, make up to 55 c.c., filter and polarize in a 200 mm. tube, the reading multiplied by 2 giving the direct polarization. Put 75 c.c. of the original filtrate in a 100 c.c. flask, add 5 c.c. of conc. hydrochloric acid, mix, and introduce a thermometer into the flask, which is then placed in a water bath heated to 72° C. When the thermometer in the flask indicates 69° C. (3 to 5 min.), the solution is kept at this temperature for exactly 5 minutes, rotating the flask gently at frequent intervals to secure even distribution of heat. Then remove from the bath, and cool rapidly. Add slowly a little more zinc dust than is sufficient to precipitate the lead, or a few crystals of sodium sulphite, bring the solution to the same temperature as that on which the direct reading was made, and make up to 110 c.c. with water of the same temperature. Filter and read the solution in a water-jacketed 200 mm. tube, noting the temperature accurately, which should be within 1° of that for the direct polarization. Calculate the per cent. sucrose from the formula: $\frac{100\,(2\,D - \frac{8}{3}\,I)}{142 - 0{\cdot}5\,t}$, in which D = direct reading, I = invert reading, and t = observed temperature of the solution.

Glucose.—Weigh out 10 grms. of the molasses, and transfer with about 200 c.c. of water to a 250 c.c. flask. Add *neutral* lead acetate solution until no further precipitate is formed, as can be noted by allowing a few drops to run down the inside surface of the flask. This usually requires about 5 c.c. Make up to the mark and filter. To 125 c.c. of the filtrate in a 250 c.c. flask add neutral potassium oxalate solution in small amounts until the precipitate settles quickly, leaving a clear solution. Fill to the mark with water, mix thoroughly, and filter. Place 5 c.c. of the filtrate in each of five test tubes, and add 4, 5, 6, 7, and 8 c.c. respectively of mixed Soxhlet's solution. Heat to boiling, allow to settle, and note which is the first tube that has an excess of the copper solution as indicated by a distinct blue colour in the supernatant liquid. Measure ten times the volume of mixed Soxhlet's solution that was used in this tube into a 400 c.c. beaker, add 50 c.c. of the filtered molasses solution (equivalent to 1 grm. of molasses), and cover with a watch-glass. Heat to boiling, and boil gently for exactly two minutes. Add 100 c.c. of cold distilled water, and filter immediately through a Gooch crucible with asbestos pad, prepared as below, using a filter pump. Transfer all the cuprous oxide precipitate to the crucible, and wash five or six times with hot water. Dry in an oven at 100°C. or over for half an hour. Heat to full redness for 15 minutes, cool in a desiccator, and weigh quickly, as cupric oxide is very hygroscopic. The weight of glucose in milligrams corresponding to the weight of cupric oxide may be found from tables.

To prepare a Gooch crucible for filtering, attach to a filter pump, pour enough washed asbestos suspended in water into it to make a pad ¼ in. thick, wash four or five times with distilled water, dry for half an hour in an oven, ignite to redness, cool in a desiccator and weigh.

Ash.—Weigh out 3 to 5 grms. of molasses into a platinum dish. Add an equal volume of concentrated sulphuric acid, and heat gently at first, and finally to a dull red heat until the ash remaining is free from particles of carbon. The final heating is best done in a muffle furnace. Add a few more drops of acid, and heat again to redness. Cool in a desiccator and weigh. Subtract 10 per cent. from the weight of sulphated ash to get the carbonated ash.

CONDENSER WATER.

From Evaporator.—To test the condenser water for sugar from entrainment, three to five litres of it are collected from a point as near the condenser of the evaporator as possible, a litre at a time, at intervals of half an hour, and placed in a perfectly clean vessel, preferably one that has not had sugar in any form in it before. The evaporation may be begun as soon as the first sample is collected. About 2 c.c. of a 5 per cent. solution of sodium carbonate are added to the water at the beginning of the evaporation. When the water has been evaporated down to about 150 c.c., the large dish is removed from the stove, and the water is transferred to a small evaporating dish, the last traces being carefully washed out of the large dish into the small one. A sheet of asbestos, with a 2½ in. hole in it, is placed on the stove with the small dish containing the water. The evaporation is continued until only about 75 c.c. remain. It is not safe to go beyond this, on account of the risk of decomposing some of the sugar. This solution is transferred to a 100 c.c. sugar flask, about 1 c.c. of basic lead acetate solution and a little alumina cream added, and made up to 100 c.c. From the polariscope reading of this solution, after filtering, its polarization can be found from tables. To find the polarization of the condensed water from this, divide by 50, since the water was evaporated to one-fiftieth of its original volume. For instance, suppose the polariscope reading were 3·0, the 100 c.c. of evaporated solution would then have a polarization of 0·78, and the original condenser water a polarization of 0·016.

The determination of the polarization of the condensed vapour of the different vessels is carried out in the same way; the amount of this water can be calculated from the tons of mixed juice entering the evaporator and the per cent. evaporation in the different vessels.

From Vacuum Pans.—For collecting a sample of water from a condenser of a vacuum pan, screw a short piece of ⅜ in. pipe (bevelled off on the inner end to catch the water coming down, and furnished with a valve near the outer end) into the water leg at a convenient distance from the floor or other support. Connect the pipe by a short rubber tube with a 5-gallon bottle of thick glass. Open the valve at the beginning of a strike sufficiently to allow the water to drop slowly into the bottle throughout the strike. Evaporate and polarize the water as just described above.

Drain Waters.

All drain and waste waters, including that from the juice heaters, evaporator calandrias and condenser, and vacuum pan coils and condensers, should be tested once a day with naphthol solution. 1–2 c.c. of the water are treated in a test tube with 3–5 drops of a freshly prepared 20 per cent. alcoholic solution of α-naphthol. Pour the solution carefully, to avoid mixing, upon 2–3 c.c. of concentrated, chemically pure sulphuric acid in another test tube held in an inclined position. A dark ring between the two liquids indicates sucrose or glucose.

CALCULATIONS.

Extraction.—When the weights of cane and mixed juice are known, this is calculated by the formula:

$$\frac{\text{Sucrose per cent. mixed juice}^{1} \times \text{weight mixed juice}}{\text{Sucrose per cent cane} \times \text{weight cane}}$$

When accurate weights are not available it may be calculated by the formulæ:

$$\text{Bagasse per cent. cane} = \frac{100 \text{ fibre per cent. cane}}{\text{Fibre per cent. bagasse}}$$

$$\text{Polarization of bagasse per cent. cane} = \frac{\text{bagasse per cent. cane} \times \text{polarization of bagasse}}{100}$$

$$\text{Extraction per cent. cane} = \text{polarization of cane} - \text{polarization of bagasse per cent. cane.}$$

$$\text{Extraction per cent. polarization of cane} = \frac{\text{extraction per cent. cane} \times 100}{\text{polarization of cane}}$$

Juice Extraction per cent. Juice in Cane may be calculated by the formulæ:

$$\text{Soluble solids per cent. bagasse} = \frac{\text{polarization of bagasse} \times 100}{\text{purity residual juice}}$$

---

[1] Ordinarily the polarization is used instead of the per cent. sucrose in these calculations.

$$\text{Juice extraction per cent. juice in cane} = 100 - \frac{100 \times \text{bagasse per cent. cane} \times \text{soluble solids per cent. bagasse}}{\text{Brix normal juice } (100 - \text{fibre per cent. cane})}$$

Juice Extraction per cent. Cane may be calculated by the formula:

Juice extraction per cent. cane = juice extraction per cent. juice in cane × (100 — fibre per cent. cane).

Mixed Juice per cent. Cane may be calculated by the formula:

$$\frac{\text{Juice extraction per cent. juice in cane} \times \text{Brix normal juice} \times (100 - \text{fibre per cent. cane})}{100 \times \text{Brix mixed juice.}}$$

Averages for all reports and records should be true averages.

EXAMPLES

Available Data—

First mill juice, Brix	18·8
Mixed juice, Brix	14·0
,, ,, polarization	11·8
,, ,, purity	84·3
Residual juice, purity	71·4
Extraction, per cent. polarization of cane (approximately)	98
Cane, fibre	12·5
Bagasse, polarization	1·0
,, moisture	38·4

$$\text{Coefficient} = \frac{\text{Brix normal juice}}{\text{Brix first mill juice}} \times 100 = 97{\cdot}4$$

Normal juice:

$$\text{Brix} = \frac{18{\cdot}8 \times 97{\cdot}4}{100} = 18{\cdot}3$$

$$\text{Purity} = \frac{(98 \times 84{\cdot}3) + (2 \times 71{\cdot}4)}{100} = 84{\cdot}0$$

$$\text{Polarization} = \frac{18{\cdot}3 \times 84{\cdot}0}{100} = 15{\cdot}4$$

Cane:

$$\text{Polarization} = \frac{15{\cdot}4 \times (100 - 12{\cdot}5)}{100} = 13{\cdot}5$$

Bagasse:

$$\text{Soluble solids} = \frac{1{\cdot}0 \times 100}{71{\cdot}4} = 1{\cdot}4$$

$$\text{Fibre} = 100 - (38{\cdot}4 + 1{\cdot}4) = 60{\cdot}2$$

$$\text{Per cent. Cane} = \frac{12{\cdot}5 \times 100}{60{\cdot}2} = 20{\cdot}8$$

$$\text{Polarization of bagasse per cent. cane} = \frac{20{\cdot}8 \times 1{\cdot}0}{100} = 0{\cdot}2$$

$$\text{Extraction per cent. cane} = 13{\cdot}5 - 0{\cdot}2 = 13{\cdot}3$$

$$\text{Extraction per cent. polarization of cane} = \frac{13{\cdot}3 \times 100}{13{\cdot}5} = 98{\cdot}5$$

$$\text{Juice extraction per cent juice in cane} = 100 - \frac{100 \times 20{\cdot}8 \times 1{\cdot}4}{18{\cdot}3\ (100 - 12{\cdot}5)} = 98{\cdot}2$$

$$\text{Juice extraction per cent. cane} = 98{\cdot}2 \times 0{\cdot}875 = 85{\cdot}9$$

$$\text{Mixed juice per cent. cane} = \frac{98{\cdot}2 \times 18{\cdot}3 \times 87{\cdot}5}{100 \times 14{\cdot}0} = 112{\cdot}0$$

MESSRS. FAWCETT, PRESTON & CO. LTD., the well known sugar machinery makers of Liverpool, have just sustained a loss through the death of one of their directors, Mr. HENRY SHIELD, who passed away last month.

Correspondence.

THE RELATION BETWEEN WATER CONTENT AND PURITY OF SYRUP.

To the Editor, "The International Sugar Journal."

Sir,—In Mr. T. Murakami's article on "The Control of Sugar Boiling," in the *International Sugar Journal* of October, 1916, he offers a formula for determining the relation between water content and purities of filmas and syrup—if conditions for best results are to obtain. He enters a constant, also, to take care whether the grain be coarse or fine.

It is undeniable that the factors that influence crystallization are: the size of the crystals' surface, and the viscosity and supersaturation of the mother-liquor surrounding these crystals. Therefore, it seems strange indeed that a formula should be presented, neglecting the temperature which will vary the viscosity.

Mr. Murakami discards Claassen's theory of supersaturation, because he found for different syrups that the degree of supersaturation was not the same. From his figures, it appears that he bases his supersaturation on the solubility of sugar in water, and not, as Claassen does, on the solubility of sugar in impure solutions.

The degree of supersaturation best for graining, varies according to the viscosity; the viscosity depending upon the percentage of gums in the non-sugars, and the temperature.

Perhaps if Mr. Murakami would include the temperature variable in his findings, and enlarge a little more upon the relative sizes of his crystal surfaces, he would be able to give us not only a most interesting article, but a practical one as well.

Very truly yours,
C. J. Moroney.

Burlingame,
California, U.S A.

THE SUGAR MACHINERY INDUSTRY AFTER THE WAR.

To the Editor, "The International Sugar Journal."

Sir,—The great question at present amongst sugar engineers is doubtless: "What is to be the position for sugar machinery manufacturers after the War?"

There will undoubtedly be a great extension of the cane sugar industry in Australia, but the machinery needed for the extensions will most likely be manufactured in Australia, as they have now very up-to-date engineering works out there and more recently any machinery required has been made within that country, as the condition of advanced payments was made to the sugar planters on that basis, owing to the fact that the bankers of the Commonwealth are largely associated with the engineering works referred to.

However, should the extensions be very large and urgent it is just possible that the engineering works in Australia will be unable to overtake the planters' demands within the time required, in which case much of the work may come to this country. There will also in all probability be a large extension of the sugar industry in Zululand and on the Zambesi, while in India further developments are probable, as there is an abundance of labour. At the same time there is the difficulty in the last case regarding suitable land and water in some places.

After the war, the two great centres for the supply of cane sugar will doubtless be the islands of Cuba and Java. The bulk of the machinery for the former is now mainly made in America whence most of the capital for running the estates is derived, while Java gets most of her machinery from Holland. However with the almost certain extension of the cane sugar industry in the British Colonies, there should be ample work for the sugar engineers in this country.

As for the beet sugar industry, there is no doubt that a great extension will take place in south Russia after the war, especially if there is an agreement between Russia and England to take this beetroot sugar at a preferential rate over that derived from other sources, and no doubt in return the British Government would desire this country to produce all the machinery required for the extension of these Russian factories, which machinery before the war came all from Germany and Austria.

Yours truly,

Glasgow. A Sugar Engineer.

Review of Current Technical Literature.[1]

PRESERVATION OF SAMPLES OF CANE JUICE FOR ANALYSIS. *E. Pitot.* *Bulletin de la Société des Chimistes de Maurice, 1916, 7, No. 31, 100-109.*

Experiments were made on the preserving power of different antiseptic substances which might be employed for samples of juices and other liquids awaiting analysis in the factory, these being basic lead acetate (100 in 110), neutral lead acetate (12 in 1000), formaldehyde (1 in 1000), formaldehyde and ammonia (1 in 1000), thymol (1 in 1000), salicylic acid (1 in 1000), and mercuric chloride (½ in 1000), while the sucrose was determined by double polarization and the reducing sugars by a colorimetric method. It was found that only the basic and neutral lead acetates in the proportions stated were capable of maintaining the initial sugar content of juices having a sp. gr. 1020 to 1080 for 24 hours at a temperature of 21° to 30° C.

IGNITION OF MAGNESIUM PYROPHOSPHATE. *S. H. Champlin.* *Chemist-Analyst, 14, 8.*

In making determinations of phosphorus or magnesium, it has been found difficult to ignite the magnesium pyrophosphate to complete whiteness, even with greatest care, when the usual methods are followed, but by following the directions here given, the operation may be carried out quickly and easily: Place the wet filter and precipitate in a "Vitreosil" crucible, and dry over a low flame, inclining the crucible on the triangle, and resting a cover against the top, so as to cause the warm gases to circulate over the paper. When the paper begins to brown. place the crucible, uncovered, in a muffle heated below redness, and smoke off the paper. Cool, and saturate with nitric acid (sp. gr. 1·42); warm gently to expel the excess of acid, increasing the heat slightly until red fumes come off. Return to the muffle, now raised to a dull red heat, and ignite until the evolution of red fumes ceases. Finally raise the temperature to a bright red heat and ignite until constant weight is obtained.

DESICCATION OF BEET PULP. *L. Malpeaux.* *La Vie Agricole, 1916, 6, 1-8.*

In France the Huillard desiccator with cone-shaped divisions has attained a high degree of perfection. One installed at Coudekerque-Branche (Nord) at a cost of £7000 treated 60 tons of pulp containing 82 per cent. of water in 24 hours, and produced 12 tons of dried slices containing 10 per cent. of water at a cost of 1s. 7¼d. per cwt (coal costing 20s. per ton). In Germany, the apparatus in favour for beet leaves and tops is that of Büttner, this consisting of three gratings placed over each other with an automatic loader. From 4-5 cwt. of fresh leaves 1 cwt. of dried leaves is obtained, and the cost of drying is given as 9¼d. to 9½d. per cwt , and its food value is 1s. per cwt., though it is sold dearer.

SUGAR AS A DRESSING IN VETERINARY SURGERY. *Gerardo Bussano.* *La Clinica Veterinaria, No. 19, 766-785 ; No. 20, 810-816 ;* and *No. 21, 829-844.*

Sucrose or glucose, preferably the latter "on account of its lower price and more suitable physical character," applied to any wound was found to act as an absorbent and antiseptic, stimulating the nutrition of the tissues with formation of a granular layer over the sore, leading to more rapid healing, and protecting from all possible infection. It acts, moreover, as a deodorizer, being thus of particular advantage in operations as cancer or frog of the foot, or others producing a nauseous smell. When used in the form of solution as a dressing, the formation of pus seldom occurs, any discharge gradually diminishing to close with successive applications, and such dressings when properly applied may remain in position for 8–10 or even 12 days without inconvenience. A solution of glucose 5–10 or 25 per cent. may be injected in the abdominal cavity, under the skin, in the joints, the trachea and the jugular vein, without any disturbance in bodily functions, and on this account may replace advantageously most physiological solutions. Summarizing, it may be stated that "by its absorbent and antiseptic healing properties, sugar constitutes a dressing of the first order which may render great service in veterinary surgery, especially in private practice, in place of ordinary antiseptic powders."

---

[1] This Review is copyright, and no part of it may be reproduced without permission.—(Editor, *I.S.J.*)

MECHANICAL ANALYSIS OF SOILS IN JAVA, AND THEIR JUDGMENT FOR CANE CULTIVATION PURPOSES. *C. H. van Harreveld-Lako. Archief, 1916, 24, No. 3.*

Mohr's method, which differs from Atterberg's in that it separates out the particles more gradually, and is more suitable for soils of volcanic origin, was used. Samples of the soil were spun in a centrifugal with the addition of water containing a few drops of ammonia. A jet of water under high pressure was made to play on the residue to disintegrate the particles, which were again subjected to centrifugal action. By treating the successive residues in this way, particles of the following dimensions are separated from it:—

From	2	to	1	mm.	..	From	0·05	to	0·02	mm.
,,	1	to	0·5	,,	..	,,	0·02	to	0·005	,,
,,	0·5	to	0·25	,,	.	,,	0·005	to	0·002	,,
,,	0·25	to	0·1	,,	.	,,	0·002	to	0·0005	,,
,,	0·1	to	0·05	,,	.	Less than			0·0005	,,

Soils of Java in which particles of 0·5 to 0·05 mm. predominate allow rain and irrigation water to filter through rapidly, and require plentiful irrigation for cane growing. They also need dressing repeatedly with sulphate of ammonia in small quantities. The texture of the soils in which particles ranging from 0·05 to 0·02 mm. predominate is very favourable to cane cultivation. They are sufficiently absorptive, and at the same time readily allow the excess of moisture to flow off. Soils containing chiefly particles ranging from 0·02 to 0·002 mm. are less favourable in texture for cane cultivation.

DESCRIPTION OF CANE VARIETIES UNDER CULTIVATION IN JAVA. *J. Jeswiet. Archief, 1916, 24, No. 12* and *13.*

An exact description of the different cane varieties while under cultivation is of importance in order to ascertain their individual characteristics, to prevent the mixture of cuttings, and to obtain a guarantee of purity and origin.

In the form of the internodes, their colour, and the mode of insertion of the leaves, some fairly fixed and absolute distinctive characters were found in the sugar cane from four to nine months old. It is chiefly, however, in the form of the buds and also the distribution of the hairs over the outer scales of the buds and on the different parts of the leaves, that a sure means has been discovered for identifying the different varieties, and for combining them in certain groups representing the same characters and probably of the same origin

A description is given of the two most important varieties of sugar cane grown from seeds in Java, and designated by the numbers 247 B and 100 P. O. J. The origin of No. 247 B is somewhat doubtful, and it is probably to be attributed to a cross of the Fiji cane with the Cheribon cane as the female parent. The variety 100 P. O. J. was obtained by accidental hybridization of the original black Borneo cane, probably with the Loethers cane. The writer believes that the latter may be identified as the male parent on comparing different characters of the cane 100 P. O. J. with those of the Loethers variety. A minute description is given of the various morphological characters of these two varieties, on the basis chiefly of the insertion and dispersion of the hairs over the buds, and on the shape of the internodes.

Review of Current Technical Literature.

NITROGENOUS MANURING OF THE CANE IN JAVA, AND THE USE OF A SUBSTITUTE FOR SULPHATE OF AMMONIA. ***J. M. Geerts.*** *Archief, 1916, 24, No. 14.*

The importation of sulphate of ammonia generally used for manuring the sugar cane having become very uncertain and difficult, the question of finding a substitute for it is one of primary importance. It appeared possible to find the solution of the problem by making a digest, from one and the same point of view, of all the results obtained for 10 years of experimental manuring of the sugar cane in the field and calculating them uniformly. This has now been done, and the results given by earthnut cakes have been compared with those yielded by sulphate of ammonia

The conclusion reached is that the former cannot be deemed equal to the latter; but that a mixture of the two manures gives better results than the use of oil cakes alone In rather sandy soils, the oil cakes produce better results than in clayey media. The nitrogen in sulphate of ammonia not being so expensive as that in oil cakes it is more economical to use the former. The production of the sugar cane is less when oil cakes are used than with sulphate of ammonia, but the richness in sugar is not affected.

J P. O.

Review of Recent Patents.[1]

UNITED KINGDOM.

USE OF SUGAR FOR THE MANUFACTURE OF OXALIC ACID. ***Emil R. von Portheim,*** of Prague, Bohemia, Austria. *14,234.* October 7th, 1915.

Oxidation of the cane sugar (or other carbohydrate) to oxalic acid is effected by the aid of oxides of nitrogen in the presence of a catalyst, and the operation is best carried out in two stages : (1) 100 parts of sugar are placed upon a slightly inclined grid contained in the upper part of a closed vessel, whereupon 150 to 200 parts by weight of nitrogen peroxide are passed through the mass, the sugar being gradually liquefied and flowing slowly to the lower part of the vessel. (2) Following this, the partially converted sugar is subjected to either of the two following treatments : (*a*) Through 100 parts of it mixed with 2 parts of molybdenum oxide (blue Mo_3O_8) and dissolved in 100 parts of water there is passed a current of nitrogen peroxide, which may be mixed with air, and as soon as crystals have formed, the solution is filtered, and more of the sugar preliminarily oxidized in the manner indicated in (1) added to the filtrate, nitrogen peroxide being again introduced; or (*b*) 100 parts of the preliminarily oxidized sugar treated as described in (1), 400 parts of nitric acid (sp. gr., 1.4), and 2 parts of molybdenum oxide are allowed to stand for some time, the escaping gases being mixed with air, the nitrogen peroxide produced liquefied, and the product of condensation allowed to continuously flow back into the vessel. As soon as the oxalic acid has crystallized, the mass is filtered, and a further amount of the preliminarily oxidized sugar added to the filtration, the process thus being continued.

UNITED KINGDOM APPLICATIONS.

REVIVIFICATION OF ANIMAL CHARCOAL (BONE-BLACK). ***M. Weinrich.*** *7259.* May 22nd, 1916.

CONVERSION OF CELLULOSE INTO GLUCOSE. ***R. A. Kocher.*** *7339.* May 23rd, 1916.

UTILIZATION OF WASTE HEAT FOR GENERATING STEAM. ***W. H. Panton.*** *7528.* May 26th, 1916.

APPARATUS FOR CLEANING BOILERS. ***H. J. Lund.*** *7547.* May 27th, 1916. (Norway, November 27th, 1915)

---

[1] Copies of specifications of patents with their drawings can be obtained on application to the following:—*United Kingdom:* Comptroller of the Patent Office, Southampton Buildings, Chancery Lane, London, W.C. (price, 6d. each). *United States:* Commissioner of Patents, Washington, D C. (price 5 cents each). *France:* L'Imprimerie Nationale, 87, rue Vieille du Temple, Paris (price, 1 fr. 05 c. each). The date given in the heading of specifications is that of the application of the patent.

United Kingdom.

IMPORTS AND EXPORTS OF SUGAR.

IMPORTS.

	One Month ending December 31st.		Twelve Months ending December 31st.	
	1915. Tons *	1916. Tons.*	1915 Tons.*	1916. Tons.*
Unrefined Sugars.				
Russia	.	...	....	....
Germany	..	..	....	....
Netherlands	....	....	....	....
Belgium	....	...	..	....
France	....	.. .	....	....
Austria-Hungary	....	....	....	....
Java	369	43,621	293,596	289,465
Philippine Islands	5,250	3,072	6,038	68,198
Cuba	24,474	2,500	359,746	553,565
Dutch Guiana	873	722	1,596	2,470
Hayti and San Domingo	....	....	280	4
Mexico	....	....	113	....
Peru	3,281	5,780	31,440	50,602
Brazil	16	5,537	23,281	8,751
Mauritius	17,818	614	111,081	80,867
British India	....	.	866	50
Straits Settlements	....	....	....	....
British West Indies, British Guiana & British Honduras	3,281	1,829	116,383	69,527
Other Countries	2,764	20	32,453	2,979
Total Raw Sugars	**58,127**	**63,695**	**976,875**	**1,126,479**
Refined Sugars.				
Russia	....	....	2,140	....
Germany	....	....	....	70
Holland	5,170	....	92,870	4,276
Belgium	....	....	....	....
France	31	. .	35	8
Austria-Hungary	....	....	....	....
Java	600	23,288	105,117	94,278
United States of America	39,512	79	188,746	267,681
Argentina	200	....	29,056	251
Mauritius	345	3	80,704	27,931
Other Countries	2	265	6,859	16,270
Total Refined Sugars	**45,860**	**23,636**	**505,527**	**410,765**
Molasses	10,242	4,336	144,773	121,599
Total Imports	**114,229**	**91,667**	**1,627,175**	**1,658,843**

EXPORTS.

	Tons	Tons	Tons.	Tons.
British Refined Sugars.				
Denmark	..	....	1	1
Netherlands	.	...	135	....
Portugal, Azores, and Madeira	.	1	19	1
Italy	....	....	1	1
Canada	2	....	16	....
Other Countries	900	123	4,764	4,472
	902	124	4,936	4,475
Foreign & Colonial Sugars.				
Refined and Candy	28	....	766	943
Unrefined	70	24	1,327	3,256
Various Mixed in Bond	....	..	...	....
Molasses	255	16	2,228	901
Total Exports	**1,255**	**164**	**9,257**	**9,575**

* Calculated to the nearest ton.

United States.

(Willett & Gray, &c.)

(Tons of 2,240 lbs.)	1916 Tons.	1915. Tons.
Total Receipts January 1st to December 28th ..	2,706,990	2,560,386
Receipts of Refined ,, ,, ..	—	386
Deliveries ,, ,, ..	2,698,430	2,593,359
Importers' Stocks, December 27th	12,638	2,923
Total Stocks, December 27th	59,249	78,959
Stocks in Cuba, December 27th	17,596	31,905
	1915.	1914.
Total Consumption for twelve months . ..	3,801,531	3,760,827

Cuba.

STATEMENT OF TOTAL EXPORTS AND STOCKS OF SUGAR, 1913-1914, 1914-1915, AND 1915-1916.

(Tons of 2,240 lbs.)	1913-14. Tons.	1914-15 Tons.	1915-16. Tons.
Exports	2,476,441	2,496,300	2,902,484
Stocks	33,531	6,802	21,255
	2,509,972	2,503,102	2,923,739
Local Consumption	87,760	89,565	84,176
Total Receipts	2,597,732	2,592,667	3,007,915

Havana, December 20th, 1916 J. GUMA.—L. MEJER.

United Kingdom.

STATEMENT OF IMPORTS, EXPORTS, AND CONSUMPTION OF SUGAR FOR TWELVE MONTHS ENDING DECEMBER 31ST, 1914, 1915, 1916.

	IMPORTS.			EXPORTS (Foreign)		
	1914. Tons.	1915. Tons.	1916. Tons.	1914. Tons.	1915. Tons.	1916. Tons.
Refined..	893,890	505,527	410,765	933	766	943
Raw	1,099,150	976,875	1,126,479	7,983	1,327	3,256
Molasses	168,852	144,773	121,599	217	2,228	901
	2,161,892	1,627,175	1,658,843	9,133	4,321	5,100

	HOME CONSUMPTION.		
	1914. Tons.	1915. Tons.	1916. Tons.
Refined	782,437	573,019	428,867
Refined (in Bond) in the United Kingdom	731,673	784,331	731,146
Raw	169,724	293,737	237,844
Molasses	165,037	145,936	113,703
Molasses, manufactured (in Bond) in United Kingdom ..	79,289	70,125	78,114
Total	1,928,160	1,867,148	1,589,674
Less. Exports of British Refined..	14,997	4,936	4,475
	1,913,163	1,862,212	1,585,199

Sugar Market Report.

Our last report was dated 8th November, 1916.

Owing to the continued control of the market by the Royal Commission on the Sugar Supply, the past year has afforded but little scope for private enterprise, although some advantage was secured by importers of West India sugars and low grade Philippine and Mauritius descriptions, private importations of which were permitted. Primarily, the latter kinds were intended, as usual, for brewing purposes, but owing to the restricted supplies of refined furnished by the Royal Commission, holders were in the fortunate position of being able to market their stocks freely, for consumption not only by manufacturers, but even for grocery purposes, at advancing values which culminated in prices above those fixed by the Commission for white crystal and granulated sugars.

Licenses for the importation of low grade sugars are now granted only on proof that such supplies will be used for brewing purposes only.

Throughout the year the Trade has been undisturbed by fluctuations in the prices of Government sugars, as the only important change in the official prices was that made in order to adjust values to the increased duties on refined sugars (namely, from 9s. 4d. to 14s. per cwt.).

According to the Board of Trade returns the figures of home consumption of raw and refined compare as follows :—

1914. Tons.		1915 Tons.		1916 Tons.
1,683,834	..	1,651,082	..	1,397,806

That the Government will restrict further the imports of sugar to the United Kingdom is regarded as certain, in view of the necessity for making more effective use of the reduced tonnage at their disposal. French, Italian, and Swiss consumption must also be affected by the increased cost of delivered sugars, owing to the high freights now ruling for neutral bottoms. The rate of about £15 per ton demanded from Java to the Mediterranean is quite prohibitive as against that of about £10 from Cuban and Eastern American ports.

The position of Java for marketing her sugars appears to be an unfortunate one, as apart from the disadvantage arising from this big difference in freight, she has to face the competition of the larger crops estimated for Cuba, Louisiana, Porto Rico, Hawaii, etc.

In the following tableau, we endeavour to show the supplies available for the actual years 1917-16-15, and select only the countries whose production and requirements affect, directly or indirectly, the statistical position in France, the United Kingdom, and the United States.

	In Thousands of Tons.		
	1917.	1916	1915
Stocks in United Kingdom, 1st January	119	137	414
,, in United States, ,,	59	79	130
Louisiana	250 (*a*)	123	216
Hawaii	575 (*a*)	545	577
Porto Rico	450 (*a*)	431	308
Cuba	3520 (*b*)	3008	2593
British West Indies, San Domingo, Demerara, and Mexico	495 (*a*)	481	463
Peru	200 (*a*)	200	220
Argentina	200 (*c*)	175	152
Brazil	225 (*a*)	194	240
Java (Export)	1550 (*c*)	1400	1180
Formosa	430 (*a*)	392	262
Philippines	220 (*a*)	315	243
Australia	220 (*c*)	200	150
Mauritius	250 (*c*)	220	215
United States (Beet)	800 (*c*)	775	780
Holland	—	4	130
	9563	8679	8273

(*a*) Messrs. Willett & Gray's estimate.
(*b*) Average of Messrs. Guma & Himely's estimates
(*c*) As the 1916 crops were practically exhausted by the end of the year, we have to assume reasonable figures for 1917.

H. H. Hancock & Co.

10 & 11, Mincing Lane,
London, E.C.,
10th January, 1917.

THE

INTERNATIONAL SUGAR JOURNAL.

No. 218. FEBRUARY, 1917. Vol. XIX.

☞ All communications to be addressed to "The International Sugar Journal," 2, St. Dunstan's Hill, London, E.C.

Cheques and Postal Orders to be made payable to "The INTERNATIONAL SUGAR JOURNAL," and not to individuals

☞ The Editors are not responsible for statements or opinions contained in articles which are signed, or the source of which is named.

The Editors will be glad to consider any MSS. sent to them for insertion in this Journal and will endeavour to return the same if unsuitable; but they cannot undertake to be responsible for them unless a stamped addressed envelope is enclosed.

Notes and Comments.

The War.

The sudden break between the United States and Germany this month, which has been something of a sensation even for war time, is bound to have a very considerable influence on the outcome of the conflict now raging in Europe. Whether Germany intended to provoke America to action or has miscalculated the length to which President Wilson's patience would carry him, there seems little doubt that the ultimate result will be a more or less complete condition of war between the two States, unless indeed, what seems unlikely, Germany climbs down and gives some real guarantees for future behaviour.

There are several standpoints from which the intervention of the United States in a European war can be viewed, and as regards some of them it is probably the case that the Allies would on the whole prefer to be left to finish their task by themselves. But in the cause of humanity, especially that suffering humanity which lies within the enemy's lines, the accession on our side of a nation so rich and influential as the United States of America is bound to be a matter for congratulation, especially if it succeeds in materially shortening the duration of the war, and clinches the resolve of the Allies to crush once for all the Prussian dreams of self-aggrandizement at the expense of small and peacefully inclined nations. And this after all is the great consummation.

British Sugar Beet Growing.

The subject of sugar beet growing in this country has received some fresh publicity lately, a meeting of interested parties being held at the Cannon Street Hotel in London last month. The outcome of this meeting was the sending of a deputation to the President of the Board of Agriculture, Mr. R. E. Prothero, to urge anew the claims of this industry on the Government. Mr. Prothero replied that the Board was entirely in favour of growing beet and manufacturing sugar in this country. Unfortunately, the present state of the law prevented any assistance being given by the Government (through the Development Commissioners, we presume) to any association which carried on such manufacture for profit. The Government, he added, were not at the moment in a position to give guarantees of interest on capital necessary for the starting of factories: but if a motion for the granting of such a guarantee were brought forward in the House of Commons, it would by all means have his support.

Doubtless as a result of this hint, Mr. Page Croft, M.P., on February 8th in the House of Commons moved an amendment to the Address in reply to the King's Speech, suggesting that, in furtherance of the encouragement to the production of food in this country, and to render it more independent of foreign supplies, the House of Commons should authorize the Government to guarantee interest on the capital required by different approved undertakings for the growth of sugar beet in this country and the manufacture of sugar therefrom. In the course of his speech he laid stress on the importance of the Government stating at an early date how we stood with regard to the Brussels Convention; and he urged the Government to tell agriculturists that they are determined to see that sugar growers in this country shall have a fair chance of establishing themselves.

Unfortunately, in the very restricted time available, the discussion of the food supply in general claimed almost exclusive attention, and the Address was agreed to without the Government making any statement on this special aspect of the sugar question.

The Sugar Consumption.

The Food Controller, Lord Devonport, has issued a sort of interim injunction to the nation, calling on the people to submit themselves to a voluntary limitation of consumption as regards three specific articles of food, viz., bread, meat, and sugar. He hopes that if this request is conscientiously complied with, it will be unnecessary to resort to enforced rationing; but it is clear from the remarks he makes when putting forth his request that the latter is only a preliminary effort, and that if it fails force will be applied later on. The fact is, he finds that it will take some time yet to arrange the details of so vast a task as rationing, and while his department is clearly taking steps to erect the necessary machinery for the purpose, he thinks it is worth while making a trial of a voluntary system before falling back on compulsion.

We should be sorry to think that there will be no response to such an appeal; but we very much fear that, while there will be a goodly proportion of the population who will try to carry out the limitation set them, the great majority will do nothing. Self-interest and thoughtlessness are too rampant even in war time. Many who would willingly submit to rationing will hang back from any voluntary effort because they lack the incentive to take a step which they see their neighbours are not troubling to follow. Others, no doubt, are unable to realize the risks run by unlimited victualling, perchance because the Government have not seen fit to paint those risks in sufficiently clear colours. But whether the appeal fails or succeeds, it is certainly justified, if only because it gives the nation a chance of revealing its conscience in the interval between now and the time when the machinery for rationing will have been completely set up.

The restriction as regards sugar is that not more than ¾ lb. per head per week should be consumed. Just before the war the total consumption per head of the population of the United Kingdom was from 85 to 96 lbs. per annum, or just about 1¾ lbs. per week. This quantity was, however, inclusive of sugar for all purposes, so it is not strictly accurate to compare it with the ¾ lb. now allowed for purely domestic or household consumption. Exact statistics as to what proportion of the pre-war quota was similarly consumed do not appear to be available, but it seems legitimate to assume that it was at least 1½ lbs., in which case the present restriction is a reduction to nearly 50 per cent. of the normal consumption. But even the ¾ lb. now allowed is considerably better than that ruling in Germany where, we believe, the ration is no more than 1¾ lbs. per month; or that in France, where the new basis of sugar supply is about 1⅓ lbs. a month. Amongst neutral countries adjacent to the war area, there is the case of Denmark, which has resorted to sugar tickets and allows but 1·1 lbs. per week per head. The restriction in the United Kingdom is, it is almost needless to reiterate, due solely to insufficiency of shipping to bring the sugar to this country, and as the shortage of freight is almost certain to continue for a considerable while, it is bound to have some effect on existing world's stocks and prices, as with the big Cuban crop in process of manufacture, there is likely to be an augmentation of stocks held up for lack of shipping facilities. This lack will be all the more accentuated if the United States is drawn into active naval and military conflict with Germany.

As regards the injunction to ration ourselves in this country, it appears that there is always a section of the populace which takes a maximum to be a minimum too and assumes, in this case, that they have therefore the right to claim as much as the ¾ lb. per head. Actually, however, it is uncertain whether there will be enough sugar going round the shops to provide everyone with this allowance, and some consumers may be forced to content themselves with less. Everything depends on how much of the sugar consigned to the United Kingdom reaches its destination, and, as will be seen below, the regulations for retailing the sugar are contingent on the assumed supply being available.

The Wholesale Distribution of Sugar in the United Kingdom.

A Memorandum issued on January 1st by the Royal Commission on the Sugar Supply stated that it had been decided to continue till further notice the present scheme of wholesale distribution of sugar which is based on the quantity supplied during the whole of 1915. British refiners are to continue issuing sugar only to their 1915 customers, and the quantities issued will be proportioned as heretofore to the deliveries of 1915, or to that portion of them which the available supplies for the time being should justify. There is to be no free sugar in 1917; any sugar imported under licence from the British West Indies through the West India Brokers' Committee will be taken into account when determining the quantities of Royal Commission sugar which should be allotted to the buyers.

It will be readily understood that it is quite impossible under present circumstances to determine in advance the exact percentage of 1915 supplies which will be available this year, and the Commission accordingly recommends to all wholesale dealers, who experience any difficulty, to arrange to deliver sugar to their customers during January on a fixed low basis of say 50 per cent., and during February on the fixed percentage of all supplies actually received during January; and so on from month to month. This method will tend to obviate the difficulties arising from the adoption of too high a basis at the commencement, and the consequent inconvenience caused by subsequent adjustments.

Government Financial Aid for West Indian Sugar Factories.

The *West India Committee Circular* learns that the Secretary of State for the Colonies (Mr. Walter Long) has agreed in principle to the Antigua Government guaranteeing part of the interest on the capital of a projected sugar factory company.

This decision marks, we hope, the advent of a new attitude towards the sugar industry in our Crown colonies on the part of the Home Government, and if persevered in is a distinctly hopeful sign for the future. Not many years ago when the Government of St. Kitts approved of a similar scheme for their island, the proposal was at once vetoed by the Colonial Office of that day on the ground that such a guarantee would be a contravention of the Brussels Convention. Are we to take it then that in the opinion of His Majesty's present Government the Convention does not now offer even a technical obstacle to giving greatly desired assistance to the British sugar industry? We must hope so; but it would be an advantageous step if the Government would at an early date enunciate clearly the general principles on which it intends in future to base its treatment of Imperial industry. Till this is done, capital is bound to exhibit a continuation of the caution hitherto displayed over financing schemes of sugar production in the British West Indies. It is mainly this lack of security for the future that has prevented these colonies from embarking on any hasty extension of their production, such as the more favoured American and Cuban interests have been fully justified in carrying out the last two years; and those critics of the British West Indian planters, who are prone to point to the fact that even the good prices for sugar which the war has brought in its train have not resulted in any great augmentation of sugar production in this quarter, should bear in mind the not inappreciable influence of this uncertainty.

The New Antigua Central.

Our same contemporary understands that the new scheme embraces the estates on the windward side of Antigua; the company has been registered under the title of the Windward (Antigua) Sugar Factory Company Ltd,, and the subscribers are all owners of estates making from 4000 to 4500 tons of sugar. The scheme is to be purely a co-operative one, most of the money being raised by debentures while the actual capital, which is to be small, will be held by planters in proportion to the area of canes they propose to grow annually for the factory. It is hoped that the debentures will be paid off in from 15 to 20 years, and the shareholders have to guarantee at least fifty acres of cane each for not less than 20 years.

Engineering Organization.

A weighty leading article appeared in a recent number of the *Engineer*, on the lack of real organization amongst the British engineering industry. It was induced by the fact that of late numerous piecemeal attempts have been made in this country to bind together manufacturing interests by so-called federations of associations which in the opinion of our contemporary are only so in name, and a strong plea is made that those bodies which are really representative of the British engineering industry should unite among themselves to carry on concerted action.

The British engineer, we are told, has not hitherto lent himself readily to co-operation, being essentially an individualist; and he has been so prosperous in the past without organization that he has been very slow to realize that without it his industry is doomed to extinction; it has required the war to wake him up, but even now he has merely got to the stage of rubbing his eyes and saying that "something must be done." The point is, however, that he has not in the main been able to determine what form the said "something" is to take.

Before the war the British engineer had two types of associations—the professional institutions whose work was mainly academic, and the employers' federations for dealing purely with labour questions; but neither of these was organized for *trade* purposes, or would undertake to carry out such work. Moreover, the general apathy of the manufacturer to his trade interests resulted in his making no concerted attempt to obtain his rights from the Government, the bankers, and the transport companies, or to lay his plans for a more efficient system of manufacturing. He had, it was true, numerous sectional associations, some of them geographical; but useful as such concerns were, they were neither wide enough in their range nor sufficiently British in their composition to rank as national associations.

This was much as matters stood when the war broke out. Then renewed attempts were made to bind the interests together. But here again there has been too great a tendency to attempt to federate local associations of manufacturers of all types, or even of non-manufacturers, instead of making the federation one of really identically-minded bodies. The existing associations which it has been desired to federate are constituted on many different lines, many overlap, while others clash in their work. While such is the case, our contemporary considers that any real federation of associations is an impossibility. Until the various associations are themselves brought into line on certain essential points of policy, any federation of them would be merely one in name, without power and without really representative authority. Yet half a dozen concerns styling themselves federations of associations have sprung into being since the war. Some of them were to revolutionize the industrial world, to do everything, to embrace everybody. Our contemporary cites as a curious instance the decision of the British Electrical and Allied Manufacturers' Association to throw in its lot with the British Empire Producers' Association, which latter was started primarily as a sugar association. We must confess that we on our part have failed so far to see what practical benefit would accrue to the larger body from being affiliated to the newcomer. It may, as we pointed out at the time, have strengthened its general political position by so amalgamating; but when it comes to details of policy, it seems doubtful whether there will be such a unity of interests that the resultant will be an effective force

The *Engineer* holds in short that engineering associations should federate primarily amongst themselves, and that for that purpose the spontaneous movement of the associations is needed. It recommends that the old-established Engineering Employers' Federation, and the British Engineers' Association (an organization which came into being just before the war and is now a powerful body) should unite their forces and secure for the engineering industry that recognition and support from the Government to which it is entitled.

Hawaii's Prosperity.

To judge by the remarks made by the President at the annual meeting of the Hawaiian Sugar Planters' Association last December, the year 1916 has been about the most profitable one that the sugar industry of Hawaii has ever experienced. Prices may have been higher in certain past years, but lower yields and higher cost of production more than offset that advantage. The average price for raw sugar obtained last year would appear to have been $111·25 (£22 15s.) per short ton, for the like of which it would be necessary to go back to 1889.

But it is realized that while the present prosperous times will be likely to continue for a few years yet, the constantly rising cost of production including labour has to be faced; and it is foreseen that the competition of Cuba and of the European nations after the war will result in a lowering of prices which will make profitable production more difficult. The Hawaiian planters are therefore well advised not to rest on their present laurels but to provide steadily for the future, by strengthening their financial reserves and by putting much needed improvements into the mills and the fieldwork. In this respect, the President emphasized to his fellow-workers the necessity for great improvement being made in the quality of the sugars which are being sent to the refiners. He felt sure that different methods must be adopted in the future if Hawaiian sugars were to cease being the least desirable and become the most so in the eyes of the refiners; at present owing to the ash content in their sugars they were at a disadvantage as compared with Cuban sugars. He urged that all plantations should agree to make a standard grade of sugar which would satisfy the refiners, and that through the Experiment Station the Association should see that this standard was complied with by all.

Her Experiment Station.

At the same meeting it was stated that the Experiment Station had had a very active year under Mr. Agee's able direction. The work relating to plantation experiments has given promise of great results, and will probably be extended through the co-operation of plantation managers. An arrangement is now in operation for training a number of young men in the agricultural and chemical departments of the station with a view to fitting them for posts as plantation managers and head overseers. The pathological division has continued its successful work in connexion with the search for parasites for the anomala beetle, and one species, the scolia wasp, has been established on the infested fields.

The Danish West Indies.

After all, the Danish Parliament came to a decision in favour of parting with their West Indian colonies to the United States for the payment of $25,000,000, and it is expected that the transfer of the islands to the American representatives will be accomplished by April at the latest. The people most affected, the inhabitants of the islands, must now feel relieved that a very unsettling period of suspense has been terminated in a manner which, if it produces a feeling of any regret on national grounds, must in the main be reassuring on commercial and industrial ones, as their new national government knows as a rule how to look after the interests of its colonies. Geographical position would suggest that these islands should be included within the government of Porto Rico; but it appears that this is exactly what the islanders demur to being done; they would much prefer to manage their own affairs under the Federal Government, and they wish to be accorded American citizenship at the outset. In view of the fact that they are on the whole very favourable to the change of nationality, it is to be hoped that the American Government will give full consideration to their preferences. That apart, it may be assumed that the agriculture of the islands, especially as regards sugar production, will soon be taken in hand in the big style one nowadays expects from American industrialists.

Peru's Sugar Production.

According to statistics published by the Peruvian Department of Agriculture, the total area under sugar cane cultivation during 1915 was 205,311 hectares (507,118 acres), an increase of 3,225 hectares over 1914. The yield of sugar amounted to approximately 262,840 metric tons, an increase of 34,785 tons over the quantity for 1914; the exports were estimated at 220,257 metric tons, consisting of 11,186 tons of white sugar, 183,914 tons of granulated, 24,227 tons of brown, and 930 tons of *chancaca*. These figures are a great increase over those of five years ago, when in 1911 the production of sugar was only 178,533 metric tons, of which 122,871 tons were exported. The rise in the price of sugar owing to the war has of course proved an active stimulant the last year or two.

Notes on American Sugar Production.

(From our American Correspondent.)

With the close of the annual beet sugar campaign in sight, the few factories still engaged in slicing being due to suspend by February 1st, it becomes possible to estimate with some approach to accuracy the probable results of the 1916-17 season of the American sugar industry.

Strictly speaking, the production of sugar within the territory of the United States is a continuous process, since there is no month of the twelve in which the sugar harvest is not under way in some part of the country. In Louisiana and Texas the cane grinding season is shortest, occupying the months of November and December, the mills ceasing operation soon after the turn of the year. In Porto Rico the grinding season begins in earnest directly after the New Year, and is just now under full headway. By April the great bulk of the crop will have been worked up. The Philippine season runs from November to May or June, while Hawaii has the longest campaign of all, extending from November to the following September. By the time the Hawaiian season begins to wane the beet factories of California have commenced slicing, one or two of them opening in July and the others in August. Further east the beet slicing begins about October 1st and continues ordinarily to the end of the year. Occasionally, as this year, under exceptional conditions a few factories run during the greater part of January.

While it is true, therefore, that the season for sugar production with us is literally without beginning and without end, it is customary to count the harvesting and grinding operations beginning in the fall and early winter and continuing in the various producing areas into the following winter, spring or summer months as constituting the season.

Thus, at the present time, the season in Louisiana and the beet growing states has reached its conclusion, while in the other producing sections grinding is well under way. The present outlook is for a total production of a little over 2,000,000 long tons exclusive of the Philippines. The Philippine crop is treated separately because, under present conditions, only a part of it is likely to seek this market.

With a Cuban production promising 3,300,000 tons it will be seen that the crops which, under conditions, seek a market here on account of tariff preference are this year largely in excess of the requirements of the American people which, at present prices, amount to some 3,600,000 long tons. The question as to the relation of supply and demand, and consequently the trend of sugar prices, becomes a question therefore of the amount of Cuban sugar that will be required by Europe. It has been the general expectation in trade circles that purchases for European account would be somewhat smaller than last year as a result of the measures being adopted by the various Governments to restrict the consumption of sugar.

On the other hand, it is realized that certain countries which, heretofore, have not found it necessary to appear here as purchasers are likely to seek sugar from this side of the Atlantic during the current year. On behalf of Russia, for example, inquiries for relatively large amounts have been made of late in this market. It is the general understanding that Russia will need during the year, several hundred thousand tons of sugar to supplement her own production and that a large part of this will be purchased over here if means of transport can be made available.

On the whole, therefore, it is anticipated that demands from new quarters will offset any decline in the requirements of countries which have been taking Cuban sugar, either direct from Cuba or in the form of refined sugar from this market, in such large quantities during the past two seasons. While it is anticipated that there may be some decline in the prices of raws and refineds during the next two months when Cuban sugar will be moving to this market in very large quantities, it is not believed that there will be any oversupply of sugar or any considerable decline in prices until after the conclusion of the war. The general opinion of practical sugar men is that the range of prices during 1917 is likely to be somewhat lower than last year, but that they will be high enough to provide a generous margin of profit.

The most disappointing feature of the past season among the sugar producers was the result of the beet crop. With an increase over the preceding year of roundly 100,000 acres in the area sown to beets it was expected that the outturn of sugar would establish a new high record for the industry. Unfortunately, growing conditions were unfavourable almost throughout the season. Cold, wet weather delayed the start of the crop. This was followed by a prolonged drought during the middle season. Heavy rains delayed the commencement of the harvest, while near the end of the season frost and snow interfered with the lifting of the beets, and in the Rocky Mountain States some thousands of acres of roots were frozen in the ground. This chain of unfavourable conditions diminished both the yields of beets and the sugar content, so that the total output of beet sugar is now placed at 750,000 tons, or about the same as in the season of 1915-16.

In all the cane-growing sections, however, conditions have been favourable, and all have increased their production above that of the previous season. The Hawaiian crop is now estimated officially at 573,000 long tons, a gain of 43,000 over last year; that of Porto Rico is placed at 457,000, a gain of 25,000; Louisiana produced 250,000 tons, an increase of 120,000. In the Philippines alone a big decrease is probable, the present estimate being 170,000 long tons as against 375,000 last year.

The sugar situation in the United States during 1916 presented one feature at least in common with the situation in Europe. This was a considerable decrease in consumption. The figures of the Department of Commerce, which are just now available, place the consumption per capita at 78·13 lbs. during 1916, as compared with 84·06 in 1915, and 89·14 in 1914. With us, however, the decline was due solely to the high prices throughout the past year, and not to any special efforts to restrict the use of sugar.

In the refinery trade the outstanding feature of the past year has been the great increase in the volume of exports. Shipments of refined sugar to other countries for the year are given by the Department of Commerce as roundly 753,000 long tons, an increase of over 320,000 tons, or approximately 75 per cent. over 1915. Prior to 1914 exports were negligible.

All this export of sugar of course was previously imported as raws from Cuba or full duty paying countries, and refined here, as under our tariff laws practically the full amount of the import duty is repaid to refiners as drawbacks in such cases. It is fully understood that this export movement is a temporary one, and that its significance is merely that American refineries are called upon for the time being to replace part of the refining capacity of Europe that has become inoperative or unavailable as a result of the war. The volume of export business during the past year, however, made it of particular importance to the refineries, especially in view of the somewhat lessened domestic demand. It enabled a number of refineries to keep in continuous operation instead of closing down for a considerable period, as they otherwise would have been forced to do, and it contributed in a degree to the satisfactory showing which these companies were able to make to their shareholders.

The History of the Sugar Machinery Industry in Glasgow.

By ROBERT HARVEY, M.Inst.M E.

Chairman of the Harvey Engineering Co. Limited, Glasgow.

The rapid rise and progress of the City of Glasgow during the last 100 years has been phenomenal, and has been chiefly due to two circumstances.

First, to the favourable position of the city, which lies in a district very rich in valuable coal fields and iron mines; these are an indispensable adjunct to Glasgow's immense industries of engineering and shipbuilding, as well as to the large iron and steel works in adjacent districts, where the raw material is produced.

Secondly, to the river Clyde, which is a channel and harbour through which imports of food and raw material arrive from all parts of the world, thus making the city a great distributing centre This river is also the outlet for the exportation of a large quantity of coal and general machinery, including engines of all kinds—locomotives, machine tools, sugar machinery, and all types of manufactured goods to every part of the world—the result of the varied industry and enterprise of Glasgow's citizens.

In the present paper the writer proposes to give the history of one of these industries, viz., that concerned with the manufacture of sugar machinery.

The founder of the sugar machinery industry in Glasgow was undoubtedly JAMES COOK, engineer, of Tradeston, a district on the south side of the river. He was born in "The Kingdom of Fife" about the year 1763, and served his apprenticeship there in a millwright's shop, engaged in the construction and erection of meal mills driven by wind and water power, also certain other machinery used in that part of the country at the time.

JAMES COOK was a superior workman, of great energy and of rather an ambitious disposition. In the year 1788 he therefore left Fife for Glasgow, and started business in a small workshop in St. Enoch's Wynd, where the present St. Enoch's station now stands, and here he carried on the calling in which he had been brought up, viz., the construction and erection of meal mills driven by wind and water power, and later on sugar mills driven in the same manner. JAMES COOK was a far-seeing man, and about this date the steam engine, as improved by JAMES WATT, was coming into use. COOK saw the great advantage such an engine would be if applied to drive sugar mills, as it was a reliable power, which wind and water power were not: and he was the first person in Glasgow to apply the steam engine to drive a sugar mill. He thenceforward decided to adapt himself thoroughly to this promising extension of his business.

Accordingly in the year 1805 he secured a large piece of ground on the south side of the river, which consisted at that time of green fields and gardens, these being planted principally with vegetables for household use, except a small part where the Barony of the Gorbals was situated. These works were of such an extensive character for those early days, that they were dubbed "Cook's Folly"; but JAMES COOK knew that he was going in for something of an adventure, and he therefore built the works in such a manner that if his engineering scheme came to grief he could convert them into dwelling houses; thus he actually had fireplaces and chimneys built into the walls of the second floor, and provision made for the joists to support the upper flooring. But this as it turned out was never required, as the business was a great success, so much so that a few years later these works were called "The College," as it was here only that young men could be trained as engineers.

Before the introduction of the steam engine, as improved by JAMES WATT, the men who were employed in the construction of meal mills, water wheels, wind mills and other machinery then in use, were called "millwrights"; but with the entry of the steam engine this title was altered to engineers and millwrights, and gradually the term *millwrights* was dropped and the term *engineers* became general.

In these works JAMES COOK, for many years, carried on what was for those days a very extensive business in constructing all kinds of sugar machinery, then used in the manufacture of sugar in our West Indian colonies. He was a good organizer, and also had an eye for the beautiful, since the framing of his engines and the headstocks of his mills were of an ornamental design and had a certain amount of architectural beauty of the Gothic kind, also the panels were relieved by many flutes of different types—so different from the plain but more serviceable designs now in use. The size of the various mills was fixed by the size of the engine driving them, and was called, say, a 12 horse-power engine and mill, 15 horse-power engine and mill, and so on, and as the horse-power increased, so the sizes of the mill were increased; and he had a standard set of patterns for each size. His engines were all of the vertical cylinder type, with overhead beam, in those days called the "Walking Beam," and all were on the condensing principle, as the steam boilers at that early period were of the "waggon" type—that is, four-sided not circular as now; the steam pressure therefore had to be very low, about 9 to 10 lbs. per square inch, but with the vacuum it gave an effective pressure on the piston of the cylinder of about 20 to 22 lbs. per square inch. Both mills and engines were very ineffective as compared with those in use at the present time.

The original drawing of one of these engines and sugar mills, as made by JAMES COOK, is still to be seen in the Art Galleries of the City of Glasgow, and the date on this drawing is 1816—just one hundred years ago.

The extraction of juice from the sugar cane by such a mill in those days was considered very good if it amounted to 50 per cent. of the juice in the cane, but owing to the very high price sugar then fetched the planter made a very handsome profit, although he lost practically one-half of the juice in his cane, the other half making good fuel in the imperfectly crushed cane or bagasse; but in addition to this expensive fuel, many sugar estates then burned from one to one and a half tons of coal to make each ton of sugar. About 75 per cent. of the cane juice is of course water, and the evaporation of this water was effected in large open cast-iron vessels called "Carron pans," the waste heat of the boiler passing underneath them before going to the chimney.

Now, in place of the old three-roller mill, we have heavy mills consisting of eleven, fourteen or even more rollers driven by very strong and powerful engines with a steam pressure of from 80 to 120 lbs., and the extraction of the juice is from 92 to 96 per cent. of the juice in the cane, according to the amount of fibre contained in the latter.

The evaporation of the 75 per cent. of water in the cane is now accomplished by means of a triple or quadruple effect evaporator, using the waste steam from the various engines in the factory and working under a vacuum, so that this work is accomplished entirely by waste steam, no extra coal whatsoever being used. These two improvements in the manufacture of sugar have thus reduced the price of manufacture from the £30 to £35 per ton in 1816 to (on some estates under favourable conditions and with up-to-date machinery) from £7 to £9 per ton, this price including the cost of planting and reaping the canes.

However, we will return to James Cook's business. He actually constructed the first marine engine built on the Clyde, viz., that of the steamboat "Albion," which was the second steamboat launched on the river in the year 1816. The old original drawing of this is also to be seen in the Art Galleries of the City of Glasgow. The first steamboat, by the way, was the "Comet," launched in 1812; but her engine was built for land purposes and was bought by HENRY BELL to place in his steamboat. In the galleries referred to is also to be seen a drawing of the first steamboat to sail in Continental waters, the "Admiral Dondolo," built by JAMES COOK for an Italian company, JAMES COOK also built the first steam dredger used on the Clyde. It was driven by paddle wheels, as it was only many years afterwards that the screw propeller came into use. The drawing of this dredger is also to be seen in the Glasgow galleries. JAMES COOK built in all about 20 sets of marine engines, also spinning machinery and large beam engines for driving mills and factories of various kinds, including meal and flour grinding mills. But the demand for sugar machinery became so pressing that he gradually dropped all other work and confined himself solely to this speciality.

JAMES COOK, who was Provost of the Barony of the Gorbals, had a very handsome country house near to Rutherglen, and drove to and from his works in a carriage with a pair of grey horses, and a Dalmatian dog running behind. The writer's father as a small boy remembered seeing this carriage driving through the barony, where he lived with his mother.

JAMES COOK died in the year 1837 and the works were bought by his manager, DAVID COOK, who, strange to say, was no relation to JAMES COOK. The site at this time extended east to the present Eglinton Street, and when the Glasgow and Greenock Railway was promoted DAVID COOK received for the portion of the ground required by the railway about as much money as he had paid for the entire works.

DAVID COOK was of a most saving disposition, and after carrying on for some years in a very successful manner this speciality of manufacturing all kinds of sugar machinery, he became a very wealthy man. In 1850 he bought the estate of Carfin, in Fife, and retired from business, but still continued to hold the ground and buildings as landlord till his death in 1865. On his retirement a new co-partnery was formed consisting of ROBERT COOK, engineer and nephew of the original JAMES COOK, ROBERT BARR, a brother-in-law of DAVID COOK, and the writer's father, ROBERT HARVEY, as managing partner.

ROBERT HARVEY entered Cook's works in the year 1838 as an iron turner. In those days all machine work was done by hand, there being no planing machines; all work was lined off on the castings and chipped and filed fair and straight by the hand, using the hand hammer and chisel, and similarly in iron turning no self-acting lathes then existed, all work being done by the hand, and the tool used was called the "heel tool", the lathe consisting of the driving head and the dead centre placed upon wooden shears, the top of which was covered by iron plates.

ROBERT HARVEY was a very powerful man, 6 ft. 2 in. in height and weighing about 16 stone; he was an expert turner, so that he soon became known as "Cook's big turner," and was the highest paid man in the works, getting 22s. per week of 60 hours. He also had great ability as an artist and portrait painter, so much so that there was a club formed by the men in the works, each paying one shilling per week for 21 weeks and each having his portrait painted for a guinea. It was this that secured Mr. HARVEY promotion to the post of chief and sole draughtsman in the works. The previous draughtsman had left Cook's to go to a much better position in Russia, and for some weeks no one could be found to take his place, as in those early days there were no schools where mechanical drawing was taught, and hence, as a last resource, Mr. DAVID COOK made a trial of his big turner, ROBERT HARVEY, who with his artistic tastes in a short time filled the position very well. But he had to suffer in pay, as DAVID COOK told him he never had paid more than 21s. a week for a draughtsman and he was not going to do so now; hence the reduction of his pay from 22s. per week as an iron turner to 21s. per week as chief draughtsman.

Shortly after this ROBERT HARVEY was appointed teacher of mechanical drawing when the Mechanics' Institute was started in Glasgow, and then for the first time young engineers had an opportunity of learning mechanical drawing in evening classes from 8 to 10 p.m.

Another firm of engineers and iron founders at this time was coming into notice, Neilson & Company, of Hydepark Street, near to the north side of the river bank. Mr. NEILSON was an engineer and the son of J. B. NEILSON, gas engineer in Glasgow, who became famous as the inventor of the "hot blast" for ironworks. Neilson & Company did all kinds of engineering work, constructing more especially at this time winding and large pumping engines for collieries all over Scotland and England. By some chance a friend of Mr. NEILSON'S in the Isle of Cuba in the West Indies sent an order to him for an engine and sugar mill, but this was out of his firm's line, and when the patterns were ready for the foundry the manager, Mr. WILLIAM TAIT, told Mr. NEILSON that he had no confidence in going on with the work, as it was all strange to him, and suggested to Mr. NEILSON that he should, if he intended to go into this line of business, endeavour to secure ROBERT HARVEY, of Cook's works, as his chief draughtsman. So Mr. NEILSON wrote to ROBERT HARVEY offering him the position at 30s. per week. Mr. HARVEY showed this letter to Mr. COOK and said if he would give him 25s. per week he would refuse the offer. Mr. COOK replied that he had never paid more than 21s. per week for a draughtsman and he was not going to do so now. Therefore Mr. HARVEY left Cook's employment in 1844 and became chief draughtsman and later manager for Neilson & Company, constructing all kinds of sugar machinery and general engineering work; and it was here that Mr. TAIT acquired his knowledge of sugar machinery under Mr. HARVEY.

When a new co-partnery was being formed of D. Cook & Company in 1850, the offer was made to Mr. ROBERT HARVEY to return to his old works as managing partner, as already stated, and the late JAMES REID, of the Springburn Hydepark Locomotive Works, succeeded Mr. HARVEY in Neilson & Company.

The firm of D. Cook & Company was carried on very successfully in its special line of sugar machinery manufacture by Mr. HARVEY until 1870, when all the partners retired except himself, but by this time the ground on which the works were built had risen greatly in value, so Mr. HARVEY removed the best part of the machinery with all the patterns and drawings to Kinning Park and there started the Park Grove Ironworks as Robert Harvey & Company, successor to D. Cook & Company. Here the special line of sugar machinery was manufactured with improved designs and more up-to-date machinery.

ROBERT HARVEY died in 1883 and the business was carried on by his manager and son, ROBERT HARVEY (the present writer) until 1888, when it was amalgamated with the business of the late SIR WILLIAM MCONIE, ex-Provost of the City of Glasgow. He was Provost during the formation of the first Glasgow Exhibition, and when it was opened in 1888 he received a knighthood from QUEEN VICTORIA, and became SIR WILLIAM MCONIE OF BALLOCHNECK, an estate he bought in Stirlingshire. The title of the firm was McOnie, Harvey & Company, and in 1902, for private reasons, it was altered to McOnie, Harvey & Company Limited, and again in 1904 to the present title of the Harvey Engineering Company Limited. The record of the Company for the last 20 years is well known to most of those who in the various parts of the world, where sugar cane is grown, are interested in sugar estates and sugar machinery.

The History of the Sugar Machinery Industry in Glasgow.

This completes the history of James Cook's engineering business from 1788 until the present time.

As illustrating the rise and progress of Glasgow during the period under review, it may be remarked that when JAMES COOK started business in 1788 the population of the city consisted of 60,000 persons; now in 1916 it is 1,200,000 and ranks as the second city in the Empire.

The old original drawings referred to in this paper were handed down to the various persons carrying on the business, and as the writer was the last direct successor, this accounts for their being in his possession. It gave him great pleasure to hand them over to the Corporation of the City of Glasgow as a record of the early engineering days in the city and on the river Clyde.

(To be continued.)

Sugar Cane Cultivation in Non-Tropical Parts of India.

An Official Rejoinder.

It will be recollected that in our issue of June, 1916,[1] we quoted a criticism of our Calcutta contemporary, *Commerce*, on the policy of the Department of Agriculture in India in devoting its energy to experimental cane work in those provinces of India which *Commerce* has declared are outside the sugar belt and therefore quite unsuitable for cane sugar cultivation; we concluded by expressing a wish to hear the official explanation of the decision not to confine attention and energy to lands in India within the recognised sugar belt.

The Department of Agriculture has fallen in with our suggestion and in an instructive paper contributed to the *Agricultural Journal of India*[2] by Mr. WYNNE SAYER, Assistant to the Agricultural Adviser, the reasons for the present Government policy are set forth with some detail. This reply is reproduced below, though in somewhat abridged form, as we have not space to give it *in extenso*.

"On reading these criticisms (writes Mr. SAYER) the first idea that strikes us is that the writer in *Commerce* has completely lost sight of the main point in connexion with the Indian sugar industry—that the problem in India is a dual one. The word *sugar* does not solely refer to the refined article which is an obsession firmly fixed in the minds of so many. There are two methods of utilizing the sugar cane when crushed, namely, the production of *gur* for eating, and the production of refined sugar either (i) direct from the cane, or (ii) from *gur*. India's production of sugar (mostly raw sugar), excluding that in Native States, is close on three million tons, of which about 16,000 tons only are exported, the rest being all consumed in the country. Over and above this she has to import over 800,000 tons of refined sugar, mostly from Java and Mauritius, to meet the continually expanding demand for this kind of sugar. She is therefore far and away the greatest producer and consumer of sugar (raw) in the world, and I would ask what country can possibly supply her with such an enormous quantity. Now the points to be borne in mind are (1) that the vast majority of the Indian population prefer *gur* which is as nutritious as sugar, or rather more so, and (2) that *gur* also enters into many Indian food preparations, and there is no likelihood of the demand for *gur* falling off in the near future. On the contrary, the increase in wages and the rise in the price of agricultural produce have enabled certain classes of the labouring and agricultural population to increase their consumption of this commodity. Again, as none of the other sugar-producing countries produce *gur* it must be manufactured within the country itself, for it would not pay to produce it abroad. These being the peculiar conditions we can now proceed to examine how far the tropical parts of India, which are more suited to cane growing, can meet this huge demand. If we refer to the total area under cane in India, we find that about 90 per cent. of the acreage is in Northern and North-Eastern India, i.e., United Provinces, Punjab, Bihar, Bengal, and Assam. Not more than 10 per cent. is in Peninsular India or what may be called the *sugar belt.* It will thus at once be seen that Bombay, Madras, and the Central Provinces cannot possibly supply the quantity of *gur* required by India. Doubtless it may be asked why not, if there is a market and the land is suitable for cane? But there are these restrictions. Extension of cane cultivation in these parts is limited by the supply of water, the competition of paddy and such other food crops, and, what is so frequently lost sight of in improving and increasing areas under a particular crop, the economic balance which must be kept level; for unless the price of food is to rise in the district the ratio between food and money crops must be kept in that state of balance, which will keep food at the lowest and yet allow the district to grow the greatest amount of money crops available, and it will generally be found that the district has calculated this to a nicety. Canal irrigation is very limited in Peninsular India and irrigation from wells has to be resorted to. This is an uncertain and costly method, and so there is no great extension of area to be looked for in these parts save where new canals are opened. This fact has led districts out of the sugar belt to grow their own cane, for the limiting of the area to the sugar belt would have the effect of forcing up the price of sugar if the demand was great from all other parts of India.

---

[1] *I.S.J.* 1916, 250.

[2] Vol. XI, Part iv, 1916.

"Another reason for its cultivation out of the belt is that cane as a commercial crop is more paying than rice, wheat, or cotton, always provided the necessary labour and water are available and the cultivator and his family do most of the labour.

"It will be argued that sugar cane occupies the land for over a year while the other crops occupy at most six months. To this the reply is that in India cultivation of any crop is taken up after the ryot has considered how much labour and cattle power he has at hand and must keep employed throughout the year. The ryot looks to his own immediate necessities first. He therefore plants a variety of crops to safeguard himself against ruin resulting from the failure of rains, and sugar cane naturally comes high on the list which is the result of a long chain of circumstances proved and tested by years of experience. India is not a country of capitalist farmers with large landed estates. She is a poor country of which the backbone is the illiterate peasantry. The holdings are uneconomic, being small and scattered. Leaving aside the question of expropriation which is unthinkable, we have to make the most of the existing situation.

"In Bengal, jute is more paying. Some increase in the area under sugar cane is also possible, but the following proverb current in Eastern Bengal will indicate the ryot's ideas about this crop. "Unless a man has seven sons and twelve grandsons he should not cultivate sugar cane." We do not therefore think there is any prospect of a large extension of area under sugar cane in Bengal. It is true that in Assam there are possibilities for development especially in Goalpara and Kamrup and Nowgong, but labour in Assam is notoriously deficient and the climate of the country in the rains is not calculated to stimulate the inhabitants to any prolonged physical exertion. Further, the waste land suitable for cane cultivation has to be reclaimed, new roads made, and in some places either labour has to be imported or labour-saving machinery, such as steam ploughing tackle, has to be introduced. All this spells capital and it is only large capitalistic concerns that can do all this. Nothing in the way of extension can be hoped for from the comparatively limited areas under cane under the ordinary ryot's conditions and to hypothecate on such a capitalistic basis when dealing with the ryot is to bring your scheme under ridicule. A man who farms on the turn of a rupee cannot discern the ultimate money saved by using steam tackle.

"Turning to Bihar we can confidently say that if there is any part of India where the development of white sugar manufacture is most promising it is here. Even before the outbreak of war the central factories working in Bihar were a financial success. In some parts cane is grown without irrigation. It is true that the out-turn per acre of cane is not high, but as the cultivation charges are in the same ratio the crop is a paying one. The *gur* produced in Bihar is of inferior quality suitable only for refining purposes and hence the cultivators are not averse to selling their cane direct to factories. In the opinion of many competent authorities practically the whole of North Bihar is suitable for the growth of cane.

"The heavy crops of cane on the Pusa farm where the soil is by no means of the most favourable type in Bihar for the growth of cane, but rather the reverse, show what can be done by improved cultural methods. The late Agricultural Adviser to the Government of India was of opinion that by the introduction of an improved cane and improved methods of cultivation in Bihar the production of sugar per acre could be raised to a very much higher figure than it is now, and it is not too much to say that it could be easily doubled. And yet the writer of the article in *Commerce* says the soil is unsuitable in Bihar. We wonder where it is possible to find better, more fertile, and more easily cultivated soil than in Indo-Gangetic alluvium. Its fertility is probably largely due to its water-holding capacity. A crop can exist in it through the hot weather when it would fail in most soils. It is true that the advent of severe cold in November affects the growth of cane and also that the crop is not so heavy as in Java, but this is not so great an evil as to put sugar cane clean out of court. We admit that in Northern India thin reed-like canes are grown. Though the sucrose-content is not very low they have a high proportion of fibre and consequently yield less juice to the mill in single crushing. In other sugar-producing countries thick canes are the rule, giving from 30–40 tons per acre under liberal manurial and cultural treatment. Here the crop does not receive that same amount of attention and as regards manuring it may almost be said that this nitrogen-loving crop practically goes without it in Northern India. It should, however, be remembered that in Northern India excluding Punjab the average out-turn per acre is never below 15 tons of cane, and the cost of cultivation, etc., does not exceed Rs. 70 as the ryot supplies his own labour and cattle power. The crop is therefore a paying one for him.

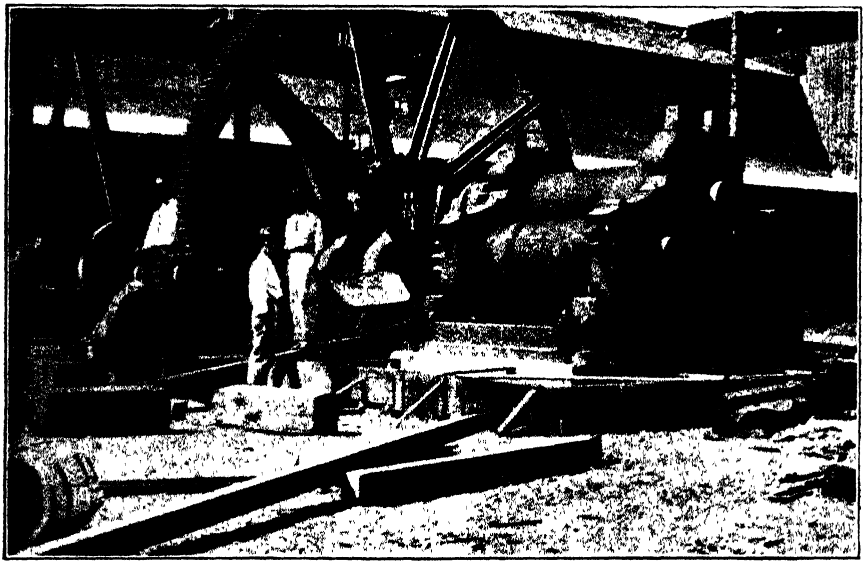
"Coming specially to the United Provinces, which have about 1,300,000 acres under cane, it is necessary to emphasize what Mr. MORELAND has already pointed out, that this crop ensures regular employment to a large number of labourers at a time when other work is hard to find, and given a good season it enables the cultivator to pay his rent and put something by, or give his family and friends a treat. Further it is the stand by of the hard-working man, calling for just as much labour as he can put into it, and there is perhaps no other crop which rewards skill and labour to the same degree. It will thus be seen that this crop is of vital importance to the United Provinces. Bengal has its jute as a paying crop, Bihar its indigo or tobacco, but the United Provinces have nothing between cane and far less remunerative crops. It is therefore not a question of a few central factories or a small class of consumers, but affects the welfare of a very large part of the rural population. It may be argued that this extensive cultivation of cane in the United Provinces is due to irrigation facilities. We admit that facilities for cheap irrigation have been greater in the United Provinces than in other parts, but so long as no equally paying crop can be substituted the ryots are wise in cultivating cane, and the Agricultural Department equally so in trying to ascertain whether it can help the ryots in increasing their yield of stripped cane per acre or in improving their methods of *gur* manufacture. In fact, while the cultivators hardly get more than 15 tons of cane per acre, on Experiment Stations 22 to 25 tons of sugar cane of a purity of 85 have been obtained. This variation in out-turns indicates vast possibilities of improvement. Already Mr. CLARKE has got a type of cane, J. 33, which is far better than any *desi* variety at present grown by the ryots. Not only is there no question of the crop being given up in the United Provinces, but there is a possibility of extended area coming under cane as the result of the gradual extinction of poppy cultivation.

"The Punjab has nearly 15 per cent. of the total area under cane in India. It is true that the climate is a very severe one in winter and tests the hardihood and vitality of plants to the utmost, and it is specially trying to sugar cane; still in districts with a fairly plentiful and secure supply of water in some form or other, cane cultivation is relatively important. The question may naturally be asked why this should be so? We have already explained the general conditions which induce the ryots to take up the cultivation of this crop. The province is not able to meet its own demand for *gur* fully, and as it is far removed from the sea-coast foreign sugar has to stand heavy freight charges which fact acts as some sort of protection. Though the out-turns are low, the ryots will not give up the crops so long as it is paying to them.

"We think we have written enough to show that in the rural economy of Northern India the cane crop plays a very important part, and hence the Agricultural Department is bound to study the crop with a view to suggesting improvements. As Dr. BARBER, the Government sugar cane expert, has pointed out, we want better, richer canes with larger out-turn in the field, greater resistance to disease, and yet adaptable to the methods of cultivation adopted by the cultivator. What is indeed needed is a hardier type of cane capable of holding its own with the canes grown under field conditions in Northern India. Such types are not usually available among the canes grown in tropical countries, and the only way to get them is to produce them ourselves. No particular variety will suit all parts of the vast area of the Indo-Gangetic plain. A series of seedlings must therefore be evolved, each one specially fitted for the particular region where it is intended to replace the local kind.

"To conclude: It is clear from the above that so long as India requires *gur* in large quantities, and refined sugar only in comparatively smaller ones, we are not justified in saying that the cane crop has no right to exist in non-tropical parts. It is only these parts that are able to supply the enormous demand for this commodity, and as cane cultivation is profitable to the ryots in these districts as it stands, it is the legitimate function of the Departments of Agriculture to institute experiments with a view to find out whether any better varieties can be substituted, or whether any improvements in the cultivators' methods of cultivation and *gur* manufacture are possible, and this opens a wide field for study. While the question of *gur* is receiving attention, the problem of white sugar manufacture is not being lost sight of. In the Gorakhpur Division of the United Provinces, and in Bihar, where sugar cane cultivation is concentrated, new central factories are springing up. We do not think it necessary to go over the beaten ground and say what experiments have already been made and what improvements effected in this industry in India. It will suffice if we refer readers to the article on the "Indian Sugar Industry," published in the *Agricultural Journal of India* January, 1916, which gives a useful summary of the present position."

A FINE CROP OF BRITISH SUGAR BEETS



AN 1851 MIRRLEES MILL AT CONSTANCIA, CUBA.

British Sugar Beet Cultivation.

Although during the past twelve months no manufacture of sugar in the United Kingdom from sugar beets has been possible, there has been no cessation in the experimental growing of these roots; and we publish opposite a photo illustration showing a portion of a field containing a magnificent crop grown during 1916 by Mr. E. FESTUS KELLY, of Newbury, who is one of the foremost advocates of sugar beet growing and beet sugar production in this country.

This photograph is admittedly good testimony to the potentialities of such a crop on poor soils. The land was bad grass, ploughed up in 1914, and sown with oats which proved a failure. It was then decided to sow it with sugar beet and to this end it was given: two ploughings, one subsoiling, two cultivatings, four harrowings, one rolling; was then drilled with 6 lbs. of seed per acre, after which it was harrowed, flathoed, singled out, and finally horsehoed. Twenty loads of farmyard manure were given per acre. The seed was old from the previous year, it being impossible to get new seed from Holland owing to the Dutch prohibition on export, yet with similar seed and a similar small quantity per acre very satisfactory results were obtained too on other farms. We understand that twelve tons of washed roots were obtained per acre from this crop.

A Unique Old British Cane Mill.

In the course of our comments last month on the controversy relating to British *versus* American sugar machinery, we had occasion to cite the case of an old Mirrlees mill made in 1851, which ran till a year or two ago at a Cuban sugar factory. We are now able to give further particulars of this remarkable instance of longevity in a sugar mill, and to reproduce a photograph showing the plant in course of re-erection in the factory yard of the Constancia Central belonging to the Cuban-American Sugar Company.

This mill was ordered in 1851 from Messrs. McOnie & Mirrlees, of Glasgow (now the Mirrlees Watson Co. Ltd.), by Mrs. MARIANA TARAFA, proprietress of the Constancia sugar estate, Cuba. It had rollers, 30 in. by 72 in. and was geared to a 20 in. diam. by 4 ft. 6 in. stroke beam engine; the headstocks were 15 in. thick, the length of the mill journals being also 15 in. and their diameters 11½ in. for the top roll, and 10 in. and 10¾ in. respectively for the front and back rolls. As for the engine, it is stated that it ran to the end of its career with the original set of bearing brasses!

The present proprietors of the Constancia estate were evidently so impressed with the record of this old mill, that instead of throwing it aside when they bought a new American plant, or selling it (it is said they were offered $2000 for the engine), they have re-erected it in the "batey" of the factory as a monument to the British material and workmanship that produced a mill in 1851 which has run from that date till 1915—a period of not less than 64 years.

Sugar-House Condensing Systems.

By FRANK COXON.

(Continued from page 19.)

PUMPS *(Continued).*

Edwards' Air Pumps.—This well-known type of pump was first used for surface condenser work to drain away the condensed steam and incondensible gases from the condenser body. Its special construction and features give it distinct advantages over other pumps for similar duties; they are: (1) Highest possible vacua easily attained; (2) simplicity in valves; (3) efficiency both as to vacuum and power.

The piston at the top of its stroke, having brought up water and discharged same, leaves no clearance to be filled with air, consequently, directly it starts on the downward journey a perfect vacuum, consistent with the temperature of the trapped water, is formed and continues until the piston nears the end or bottom of the stroke when the inlet port is uncovered and the air in the body being evacuated rushes into that almost perfect vacuum formed between the top of the piston and lower side of the pump barrel head, this latter containing only discharge valves.

The lower end of the pump bucket is made conical which allows of very much higher speeds being used than in the old torpedo or plunger pattern, special leading channels being arranged to direct the flow of displaced water to the top of the piston.

On *wet systems* they possess the same disadvantages, however, that is, their unsuitability to deal with large capacities owing to structural difficulties and expense. For small installations, however, up to, say, 10,000 lbs. of vapour per hour, they can be confidently recommended as being extremely efficient although more costly.

On *dry systems* they find much favour, and to the foregoing advantages must be added now: (4) Adaptability to electric drive. Up to the present time for high efficiency, that is, high vacuum and low power, the dry Edwards' pump holds first place.

Capacities.—

Wet type: 6 cub. ft. gross displacement per lb. of vapour.
Dry type: 3¼ cub. ft. gross displacement per lb. of vapour.
Speeds of wet pumps: 200–220 ft. per min.
Dry pumps: 280–300 ft. per min.
Brake horse-power: On the above proportions the power absorbed would be approximately: wet, 5 to 6 B.H.P. per 1000 lbs. of vapour per hour; dry, 2 to 2½ B.H.P. per 1000 lbs. of vapour per hour.

It should be noted that on this type of pump a full load torque occurs right at the commencement of the starting up, due to the aforesaid feature of there being no clearance between the top of the piston and discharge valve cover and that as there are no suction valves, a complete vacuum is maintained right to within a short distance of the end of the stroke when the inlet port opens up. A horizontal pattern pump of the usual type simply draws the air out at the pressure contained in the body to be evacuated. The clearances of the ports and piston with cylinder cover always dilute the vacuum; the equalizing port, however, gets over this to some extent though not entirely effectively.

Regarding type, it is always to be recommended to adopt triple barrel pumps; although more costly in the first installation smoothness of running quite outbalances this drawback.

Rotary Air Pumps.—It is an American way of explaining the use of a crank and connecting rod to say a machine is of the rotary or rotative type in distinguishing it from those of the duplex pattern or crankless type; the term here, however, is used in the British sense of purely rotary as distinguished from the reciprocating patterns. There are many types of rotary pumps but only a few of any practical use for sugar-house work. These are known as "valveless" pumps and take three forms: (1) The Leblanc, (2) the Rees, and (3) the Johnston. The first two are what are known as water jet throwers, and can quite sufficiently be explained for our purposes by saying they consist in the main of a revolving wheel throwing off many jets of water in the form of continuous slices. These slices of water fly across space containing the air to be evacuated and the now so-called "sandwiches" of air and water are projected down a taper and properly designed nozzle to the atmosphere.

It will be obvious that in the absence of glands, piston rings, etc., the highest vacuum obtainable for a commercial machine can be reached by these pumps, but would-be users should bear in mind that, whilst rotary pumps in general are a *sine quâ non* for central station work requiring a vacuum one inch off the barometer, their successful adoption in the sugar-house needs careful consideration.

These pumps working as they do by sending "slices" of water across the air space have to be revolved at very high speed to impart the necessary energy to these "slices" of water, so that the discharge against atmospheric pressure can be easily maintained. It is this energy which, through being unable to be used up once it has done the work of trapping the air, makes these pumps great power absorbers. The powers required to deal with 27 in. and 29 in. vacuum are practically identical, and therefore for high vacuum working they are ideal pumps, but at vacua like 27 in. and 26½ in. the power absorbed may be considerably more than that of a reciprocating pattern. The power absorbed is practically the same for all loads light or heavy.

The main advantage of rotary over reciprocating pumps is the adaptability to electric drive and simplicity in working parts, features which for very large installations, such as 40,000 lbs. of vapour per hour, appear to outweigh any considerations of high power consumption.

Both the Leblanc and the Rees pumps have a feature which is interesting, though not investigated as well as it might be, and that is the property of being able to evacuate chambers up to about 20 in. vacuum at the same time as the main exhaustion is going on. The "slices" of water continuing their path through specially designed channels have their surplus energy and can therefore be used in the form of ejectors, the discharge channels being arranged in an ejector form, and by connecting these up to a chamber under atmospheric pressure they can be exhausted to about 20 in. vacuum. This applies particularly to the Leblanc pump, but similar arrangements can also be fitted and worked from the Rees.

It is common practice to use this auxiliary exhausting on the calandrias of the evaporators, exhausting the incondensible gases, but in some instances the application has been abandoned, not through actual impracticability, but more for want of sympathetic treatment.

Johnston Patent Pump.—A unique form of valveless pump of the rotary type is that bearing the name of Johnston. In it we have absence of clearance ports, valves, and piston rings, exactly as the already described rotary pumps, but the flying "slices" of water are eliminated with a consequent reduction in power as the inconvertible energy of these "slices" has not to be supplied. It is a very simple machine, yet difficult to describe in action, and it will be near enough here to sum it up as containing a rotor made with spiral chambers, and revolving in a ring of water concentric to the main case, yet the rotor centre is eccentric to the latter. The spiral chambers literally screw the air out. The economy as regards power consumption is claimed to be of no small magnitude, and great developments are expected.

Other Dry Air Pumps.—There are many types of dry air pumps other than those described, but mostly of the valve type where rotary pumps are being considered.

These latter types, whilst fairly efficient when new, soon wear to pieces on working at high vacuum, but they are most useful in large centrals for the preliminary evacuation of the pans before recharging after a strike, and are now being extensively used for this purpose.

MULTIPLE JET CONDENSERS.

So far this pattern has been confined to combinations where the Leblanc pump is used, and in principle represents a parallel flow condenser. Steam enters at the top, meets whirling jets or sprays of water, and the condensate falling down is taken away by a centrifugal extraction pump working on the same shaft as the Leblanc rotary air pump. This extraction pump is used as the majority of these installations, being placed on the low level, the air and incondensible gases rise to the top, and are extracted by the air pump. Where the cooling water is required to be pumped back to the cooling towers an auxiliary pump is used, coupled up on the same shaft and all driven by the one motor.

Great economy of space and apparent economy of power are the advantages set out for this system, and it finds favour in a few American sugar-houses—being of Westinghouse design and manufacture.

ROTARY CONDENSERS.

A unique form of condenser is the Rees Roturbo patent, manufactured in the form of a rotary turbine pump, embodying the well known Rees Roturbo self-regulating features. Jets or sprays of water are sent across an annular space, and entrap the vapour as well as air in the mixture as it comes from the evaporators. In appearance the condenser represents an ordinary turbine pump installation, and is used at low level, delivering the hot cooling water and condensate at a common outlet to flow away by gravity. Similar connexions can also be made to these condensers for the evacuation of starting up bodies.

Here again economy in space and adaptability is claimed in the advantages, but so far power consumption is likely to be no smaller than with the Leblanc type of air pump when compared in terms of overall power for air and water.

CENTRALIZATION.

It is frequently put forward that central plants doing the whole of the work of the factory are much simpler and less costly both in first installation and running expenses. Undoubtedly this is so, but little else can be said for the system ; and when gone into these so-called advantages have little real value. The evaporators usually have a constant duty to perform at a constant temperature ; while successful pan work depends on absolute control of temperature which is often required within a wide range, and this is only accomplished by variation in the vacuum. Here, then, is one reason why central condensation is not favourable to both the evaporating and the boiling-house.

Variation can be achieved by the isolating sluice valves on the vapour mains, but this is not satisfactory, and it is a well known fact that a tight sluice valve has yet to be found. Separate condensers offer much easier control of temperature by regulating the injection water; any trouble from leaking valves is eliminated and the evaporators are not disturbed in their work. There is no necessity, however, for separate air pumps and water pumps.

Perfect control can be had in centralization of these items, being merely the operation of small and perfectly fitting valves. Large factories, however, find it convenient still to keep the evaporators on their own condensing plant, and it is certainly the ideal with the pans on separate condensers to have but one pump for air and one for water. Opinion is very much divided on the point, but this latter arrangement is now held to be the best working one by the majority of practical users.

Injection water.—There are three methods in vogue for feeding water to the condensers:—(1) Pumping direct; (2) suction direct from high level tanks; (3) suction direct from low level tanks.

Pumping direct.—A frequent source of unnecessary water consumption is the ill controlled supply valve of the pumping engine. Whilst it is used when variation in temperature is required, say just at the finish of the strike and with proper effect, yet directly full vacuum is required away the wheel is turned to full bore again.

It will be found by careful observation that in many cases the supply of water can be cut down to no small extent without appreciably affecting the vacuum. There is in all condensers a critical point, in relation to the vacuum obtained and the temperature of the cooling water exit, called the condenser efficiency. It is a comparison of the actual quantity of water required to condense a given amount of steam with the theoretical quantity necessary. Once then this point has been reached any extra water is only waste both in power and water, and by constant observation of the tail water much greater efficiency can be obtained in this station.

There are a few good indicating instruments on the market at the present time which allow of accurate and constant reading of the tail water temperature and such that can be placed within easy sight of the injector water valve, so that all variations of pressure and temperature can be read instantaneously and the quantity of water controlled intelligently thereby.

Centrifugal pumps of the ordinary type are not self-regulating, that is, as the vacuum increases and thus reduces the actual head against which the pump has to work; the capacity or quantity of water delivered is increased automatically and in very much greater quantities than required. It is advisable in all large plants to use those patterns of pumps termed self-regulating, which show on test curves constant horse-powers for varying heads.

High level supply tanks.—These tanks are generally arranged about 5 ft. below the suction inlet to the condenser and contain about ten minutes' supply. On account of their size and cost, they are rapidly going out of use and very few new installations are arranged on these lines.

A much more convenient form of working whilst giving the same advantages is to use a tall cylindrical tank about 4 ft. in diam., and having a high water level of some 8 to 10 ft. from the condenser inlet. The various condenser pipes are led to the bottom of the tank and a high water level kept by fitting a float control on the centrifugal supply pump steam valve. Very much more efficient work can be done by thus having an automatic control on the pump instead of as in the direct supply system, where throttling of the water pipe has to be resorted to, such an arrangement being neither good for the pump nor for steam economy. This, however, does not eliminate the desirability of indicating instruments for the visible control of the tail water temperature.

Low level tanks.—These are confined to low level condensers which do not require any injection pump, notably the Westinghouse-Leblanc and Rees Roturbo.

(To be continued.)

Modern Practice on the Mechanical Side of Sugar Production in the Hawaiian Islands.

The following résumé of the "standard practice" in raw sugar manufacture as practised in the mills of the Hawaiian Islands was prepared by Messrs. R. RENTON HIND and E. KOPKE, and presented before the meeting of the Hawaiian Planters' Association in December, 1916.

Cane Scales.—Nearly every factory using railroad transportation is equipped with two sets of track scales for weighing filled and empty cars. Few, however, of the scales are equipped with what is known as a registering beam, and the adoption of this device should eliminate many of the errors which are bound to occur when the recording of weights is left to the weigher.

Unloaders.—The adoption of the Wick's unloader is becoming more general, due to the fact that it is the simplest form of unloading so far devised. There is need for a device for moving the mechanism from side to side mechanically, for on the large type of unloaders the handling of the machine is only possible when the unloader man is of large stature. The introduction of Filipino labour in our mills means that the average cane unloader man will not weigh more than 140 or 150 pounds, making the process of unloading a very difficult task, and something is needed to make its operation as easy as possible for the operator.

Cane Carriers.—The mills in the Kohala district in Hawaii have for many years used iron slats about one-eighth inch thick by seven and a quarter or eight inches wide, for the reason that they have found that their life is a great deal longer than that of the usual wood slat. Many plantations, however, use a bevelled wood slat, which prevents the chopped pieces of cane from falling through the carrier after the cane has passed through the revolving knives, but the use of the bevel slat makes it difficult for the water from cane flumes to run off the cane carrier. Another feature in favour of the iron slat is the fact that the cane when falling on to the carrier will in time wear the wooden slats unduly. From time to time new types of cane carrier chain are being adopted, but the old-fashioned chain using T bolts when equipped with rollers seems to be very efficient.

Revolving Knives.—The introduction of the Meinecke knife hub has been a signal success in that it has allowed the use of a multiplicity of knives which prepare the cane very well for the mills. They require considerable attention, which, of course, is to be expected, and the power required to drive them is about 12½ H.P. per lineal foot of cane carrier width. Seven of these revolving knives have been furnished to Hawaiian mills by the Honolulu Iron Works Company since their introduction within the last two years.

Carrier Clutches.—The universal use of the Moore clutch seems to prove that this type is meeting the needs of the day.

Crushers.—The Krajewski crusher is fast giving way to the Fulton or grooved type, particularly with the introduction of the multiple knife sets and the Searby shredder, as it has been found that the Krajewski crusher, while it breaks the cake up very efficiently, extracts but very little of the juice.

Searby Shredder.—The last two seasons' experience with this shredder has shown that the most advantageous position for it, in relation to the other milling machinery, is between the cane carrier and the subsequent milling machinery. In the 10 installations designed and sold by the Honolulu Iron Works Company, the following arrangement has been carried out. The cane from the carrier is cut by revolving knives and passes through the shredder; from here it passes on to the roller mills, or crusher if there is one. Four of these installations are for Formosa.

Mills.—Owing to the introduction of the juice groove the need for the inclined type of housing is no longer felt, as the pressures exerted upon the top roller by the feed and discharge rollers can be very nearly equalized. Steel housings are replacing housings made of cast-iron almost universally, for the reason that a simpler method of attaching the king bolts is brought about by the use of steel, and the liability of housing breakage is reduced to a minimum. The placing of the jacks on the top of the housings is now considered good practice, and the introduction of devices for shifting the jacks forward or backward is still adhered to by some on account of its simplicity of construction and positiveness of holding the cap in position.

The old style intermediate slat conveyor is gradually being eliminated in favour of the new designs, such as the Ramsay and the Ewart, which allow of a cleaner mill and do away with a great deal of the breakages which occurred in the old system.

Juice Strainers.—The present types of slat and chain juice strainer leave much to be desired, as they are always dirty, take up a great deal of room, are continually breaking down, and always are a source of infection to sweet cane juices. It is hoped that something will be done in the near future which will give us a simpler form of strainer.

The use of centrifugal pumps for handling mill juices as well as mixed juices is gradually coming, replacing the direct-acting pumps, which were constant sources of trouble through breakage of valve stems, etc.

Boilers.—With the introduction of the steam turbine for driving Searby shredders and auxiliaries throughout the sugar-house, has come the necessity of higher steam pressures than can be made by return tubular fire-tube boilers. Several installations are being made of water-tube boilers of the Stirling type. The Babcock & Wilcox boilers have been in use on two plantations on Oahu for many years, but they have not given the success which can be rightly expected from water-tube boilers especially designed for sugar-house work. In the 7 × 20 ft. return tubular boiler we have reached the limit as to size of boilers, and the need for higher pressures which would require heavier plates in boiler construction makes it impracticable to design boilers of this kind to carry pressures over 150 pounds per sq. in.

Furnaces.—There has been considerable experimenting done of late on spacing between the bars of the inclined grates and the angle of inclination necessary for the efficient burning of bagasse of mills equipped with Searby shredders or from mills where the crushing is so efficient as to practically powder the bagasse. The Gianca-Keech furnace has met with approval, due to the fact that it is designed on the right principle, and its adoption will undoubtedly be general before very long.

Boiler Feed Pumps.—There is a tendency toward the installation of the steam turbine or motor-driven multi-stage centrifugal pump for this purpose.

Juice Heaters.—We still adhere to the so-called Deming type of juice heater because it is the simplest form of heater known to us. Its cleaning, however, is a big problem, and much can be done towards eliminating this trouble.

Settling Tanks.—There are a number of advocates of the continuous type of juice settler, but those who believe that intermittent settling is satisfactory far outnumber those in the former class. The mills, however, are working now toward the adoption of tanks of a very large capacity in order to cut down the cost of manipulation and radiation losses. The continuous settler, however, has many advantages and may yet succeed the intermittent type if a continuous settler giving clear juice constantly can be devised.

Evaporators.—While a number of film evaporators have been tried in the islands, present practice seems to point toward the adoption of standard multiple effects, as changes in the design during the last few years have led to remarkable evaporation efficiencies which have equalled the results obtained from film evaporators, and the fact that standard submerged effects can be easily cleaned has led to their readoption almost universally.

Filter-Presses.—This station has been one of the eyesores of the modern factory for many years, and while numerous new types of filters have been given a trial, the old plate and frame press seems to meet present conditions best. Much improvement, however, can be made in the design of these presses for reasons best known to the mill operator, and we should see development along these lines in the near future.

Vacuum Pans.—The calandria type of pan, owing to its efficiency and ease of cleaning, is gradually superseding the coil pan, which has been in use for so many years in these islands. Remarkable evaporative efficiencies have been noted with pans of the calandria type, and the remarkable circulation observed in a well-designed calandria type of pan has led to its general adoption.

Crystallizers.—Modern practice in Hawaii points toward the unjacketed U-shaped type of crystallizer with the driving arrangement so made as to operate each crystallizer individually by means of a friction clutch, or tight and loose pulleys, attached to each unit.

Centrifugals.—For "shipping" sugars the mills of these islands are gradually adopting 40-inch centrifugals and using the smaller or 30-inch machines for low grade work. While there are advocates of the water-driven machine, the properly constructed belt-driven centrifugal seems to meet power requirements admirably. Sugar dischargers are rapidly coming into favour, particularly as the 40-inch machine is difficult to discharge manually by operators of small stature.

Sugar Room Equipment.—The modern sugar room is not complete without an automatic weighing machine and bag sewing and bag-marking machines. These devices have in the last few years demonstrated their worth and are being used more and more each year. Under the centrifugal the grasshopper conveyor seems to be best suited for the conditions existing there, and is replacing belt and slat conveyors almost entirely.

The extension of the sugar industry in Jamaica centres round the provision of capital for erecting sugar centrals. Opinion in the island holds that if the Government Savings Banks were re-organized and the rate of interest increased, the fresh deposits of money accruing would be ample to allow the Government to provide on loan the capital necessary to erect and carry on such sugar centrals.

Automatic Conveying and Elevating Machinery.

A Useful American Invention.

With the remarkable increase in the size and output of cane sugar factories in various parts of the world which has been a notable feature of the last ten years, the problem of the cheap and expeditious handling of the sacks or packages of finished material has naturally come in for increased consideration. Where factories were of only moderate output and native labour was plentiful and cheap, there was no difficulty doubtless in man-handling the goods. But labour is now getting less plentiful; with the spread of education amongst even coloured races the inclination to work for white employers for a comparatively small pittance is much less prevalent. It is indeed a far cry to the old days when slavery or semi-slavery offered the tropical sugar manufacturer an unlimited supply of cheap labour. Hence with the changing conditions there is greater desire on the part of such manufacturers to seek for labour-changing appliances.

Whether sugar is shipped as soon as produced or is stored in sheds attached to the factory to await a more favourable moment for placing on the market, its expeditious conveyance from the bagging department to store, rail or ship necessitates a good deal of labour in terms of man-power. But here the inventor had come to our aid and ingenious conveying, elevating, and stacking apparatus has been designed to expedite the process and reduce the number of hands employed, thereby greatly decreasing the working costs. These machines are made by the Brown Portable Elevator Company of Chicago, and they are coming in for very extensive use not only in sugar factories but also in numerous other industries and at a great number of ports and shipping warehouses all over the world.

In the ordinary method of hand piling, the bags are passed up from tier to tier by men standing on the various levels. Each tier requires at least two men; thus for a pile five tiers high ten men would be required. With the Brown Portable Elevator in use, only the men on the top tier and on the floor level are needed, while the machine is so adaptable and so easily shifted from position to position that there is no appreciable waste of time in deviating the position of the stream of sacks. Actually, the saving claimed over hand methods is put at anything from 50 to 85 per cent. according to circumstances.

The Brown apparatus includes four general types: the Standard Elevator or Piler; the Combination Elevator, Conveyor and Unloader; the Sectional Conveyor; and the Portable Loading Machine. The general design is similar but there are variations in size, weight and details according to the class of material to be handled. The Standard type consists of a frame of structural steel mounted on ball-bearing castors. To this frame is attached an adjustable carrier of steel trusswork with sheet steel bottom, over which runs an endless series of carriages specially designed and spaced to provide suitable support for specified packages. The frames are made in various lengths according to the length of the carrier, to give the machine stability and to support the weight of the carrier with its load, and the motive power. The carrier is pivoted to the frame at its lower end, the upper end being supported and adjusted in height by an upright framework of iron piping or structural steel. This support is connected by a steel cable on each side of the carrier to a raising device mounted on the frame of the machine, by which the carrier is raised as the pile increases in height. The receiving end of the carrier is placed low so that it will pick up the sacks from the floor without the necessity of lifting, and in case of bulky and inflexible materials such as bales, boxes and barrels it necessitates only a very slight lift. The packages are delivered at the most convenient height to the men standing on the top of the pile, who place them in position.

The Combination type of Piler and Conveyor (Fig. 1) differs only from the Standard type in that here there are two carriers, the lower one being stationary and the upper one adjustable to any angle for piling to any desired height. This upper carrier can also be set in a horizontal position to act as a conveyor or a car loader; and it may likewise be used as one unit of the Sectional Conveyor system (Fig. 2), which latter consists of a given number of sections or parts which are either supported on platforms mounted on ball-bearing castors or else directly on castors. All sections are interchangeable, so that a system can be made up of any length merely by adding or taking out single sections.

FIG 1.
Brown "Auto-Piler" in Operation in Cuban Sugar Warehouse.

These Brown Portable machines are also classified in three types, depending on the size and weight of the materials handled. Within these limits they can handle from one to two tons per minute, raising to a height of from 15 to 35 feet and carrying loads weighing up to 1000 lbs. per package. The medium size, class B, deals with ordinary bagged materials up to about 400 lbs. and has a standard carrying width of 24½ inches. But barrels, kegs, bundles, rolls, and even material in bulk can all likewise be dealt with, though variations in the holding or gripping arrangement of the carriers are needed for particular loads. And it must be noted that these conveyors are all reversible and will equally well unload a pile for shipment, thus saving considerable risk of the packages being damaged in descent.

The machines in their smallest sizes can be worked by hand, but generally speaking they are fitted with electric motors or gasoline, steam, or air engines of 2 to 5 or more H.P. The smaller machines can be wheeled easily over almost any floor by two men, while the larger sizes, such as are generally employed in handling raw sugar, are provided with self-propelling mechanism. The carriers travel at a speed of about 50 ft. per minute, which gives a capacity of upwards of 80 tons per hour. The entire operation of the machine is under the control of one man who has all the levers within easy access. And it is claimed that the Auto-Piler with four men will do more work in one hour than a dozen men can do by hand in three.

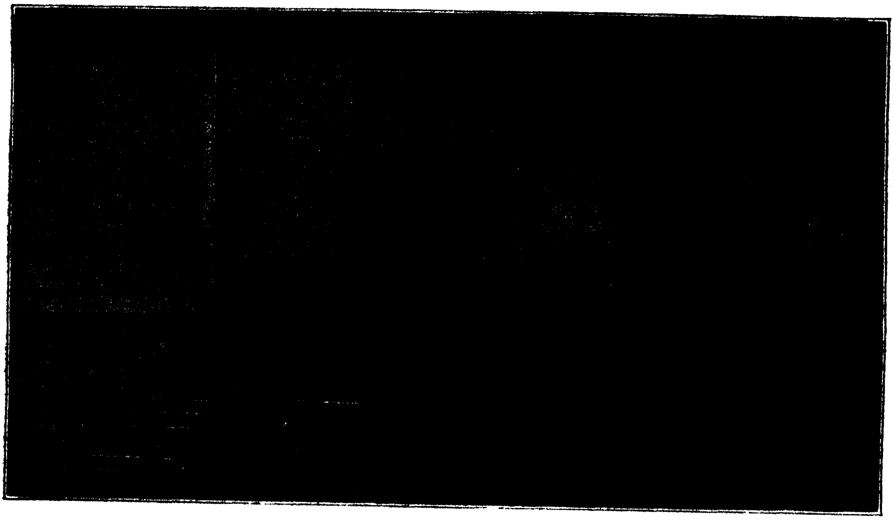


FIG. 2.
Brown Sectional Conveyor or "Interveyor."

For loading or unloading wagons and cars, for piling to any height in a warehouse or in the open, for elevating goods to upper floors, and for conveying packages from department to department in warehouses and mills, these Brown portable elevators and conveyors stand unrivalled; and it is not surprising that their use is spreading rapidly, and that during the last few months the makers have had to extend their manufacturing capacity to meet the demands from all over the world for apparatus.

The U.S. Navy Department issues the specification of a standard boiler compound, which stipulates a mixture which on analysis must show at least 76 per cent. of sodium carbonate, 10 per cent. of trisodium phosphate, 1 per cent. of starch, and sufficient cutch to yield 2 per cent. of tannic acid, the remainder to consist only of water and impurities such as are common to the ingredients mentioned. According to Mr. A. H. BABCOCK in a paper read before the American Society of Mechanical Engineers, the compound can be used for all boilers under any conditions of steaming without a material change in the formula, but the boilers must be treated individually. The cost is given as about half that of the ordinary boiler preparations.

New Observation Tubes for Saccharimeters.

By H. PELLET.

Messrs. BELLINGHAM & STANLEY, Ltd., of London, have submitted to us two new observation tubes, asking our opinion regarding them.

(1) *Jacketted tube for reaching liquids even at a high temperature.*—By reason of its ingenious construction this tube presents a real improvement. Although generally liquids are polarized at ordinary temperatures, in many cases and in special investigations it is necessary to use different temperatures. It has not been the custom hitherto to raise liquids to very high temperatures, by reason of the defective construction of the tubes which cannot be used for liquids of 80°-90°C. or higher. In fact these tubes are constructed in such a manner that expansion of the glass cannot take place, breakage being the result. It is usual to fix the glass tube in the outer metallic envelope by means of special non-expanding cement, forming contact both with the glass tube and the metallic envelope. But Messrs. BELLINGHAM & STANLEY have adopted a very ingenious construction allowing the complete expansion of the glass at any temperature. They have obtained the desired result by using only rubber rings at both ends of the tube, these rings being placed in such a manner that a screw enables them to be sufficiently compressed to give a perfect joint without at the same time hindering the expansion of the tube on heating, or its contraction after cooling. And the central tubulure serving for the introduction of the liquid is itself maintained by a rubber disc which expands by means of a screw making a proper joint, this new design being one that enables the glass tube easily to be replaced by another.

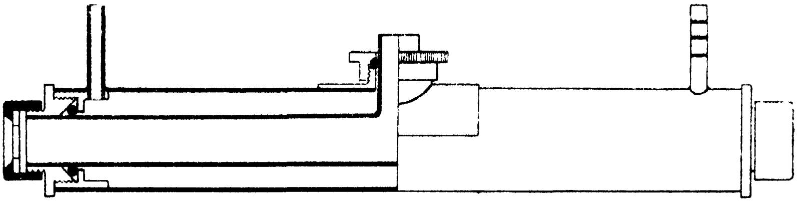


FIG. 1.

Messrs. BELLINGHAM & STANLEY have determined the coefficient of expansion of the glass used by them for the construction of their special tubes, and the formula which is used by the Bureau of Standards is as follows:—

$$L_t = L_{20}\,[1 + \beta\,(t - 20)],$$

in which β is the coefficient of expansion of the glass of which the tube is composed, and which is equal to 0·000008. This equation, which is correct to within 0·05 per cent., in spite of small variations in the composition of the glass, shows that for ordinary temperature the increase in the length of the tube is very slight, and indeed is negligible.

(2) *Tube avoiding the effect of air-bubbles.*—When neither our continuous tube, nor the tubes of 200 or 400 mm. having a central tubulure are used, the ordinary glass tubes closed by glass discs and screw caps at the ends are employed. When the tube has been filled with liquid, it is closed and taken to the saccharimeter; but very frequently the presence of bubbles of air in the tube is noticed, compelling the operator to refill it.

New Observation Tubes for Saccharimeters.

A special tube for avoiding the influence of air-bubbles in the liquid has already been designed, and the means adopted by Messrs. Bellingham & Stanley for remedying the inconvenience is to make a bulb about the middle of the tube, in which cavity the air-bubbles lodge, and the saccharimetric observation can be made. This construction also obviates the use of two sizes of glass discs and rubber washers.

This bulb has another advantage. It forces the operator always to place the tube in the same position. A further improvement would be to have some kind of mark on one of the metallic ends of the tube, in order to place the tube always in such a way that the mark is turned toward the observer. This is very important. As a matter of fact, if one carries out experiments with tubes filled with water or sugar solutions, one may sometimes establish appreciable differences due to the placing of the tube.

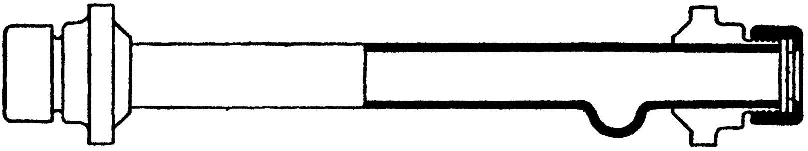


Fig. 2.

For example, if after having made a first reading, the tube be rotated even a quarter turn, and another reading be made, it is possible to have a difference of 0·1 or 0·2° *V.*; while after half and three-quarter turns, one will have four observations that may differ one from the other at most by sometimes 0·3° *V.* Lastly, if after these changes of position one reverses it, so that what was previously the end is now the front, further differences in the reading may be observed, and between the maximum and the minimum it is possible to have 0·4° *V.* difference, these variations depending upon the quality of the glass discs and the parallelism of the ends of the tubes.

Hence, it is always desirable to place the tube precisely in the same position in the trough of the saccharimeter, in order to have exactly comparable readings, and this may be easily accomplished by the use of a mark that is outwardly visible.

In order further to make the arrangement of the tube quite the same, marks should be made on the discs, so that they may be replaced always at the same spot and on the same side. And it may be added that by making the bulb, not in the middle, but towards one end of the tube, an easy means is provided for ensuring that it shall be placed with the same end always nearest to the observer. This is what has been done, in fact, by Messrs. Bellingham & Stanley.

It is evident that for all readings to be comparable it is necessary that the source of light shall remain fixed, a condition that to-day should no longer present any difficulty when the illumination of the instrument is effected by means of ordinary gas, of gas with an Auer mantle, of alcohol or of petrol with an Auer mantle, or of petrol alone, or again by means of electricity.

It is of interest finally to add that the makers guarantee the exact parallelism of the end faces of their tubes, and also their exact length within 0·05 mm.

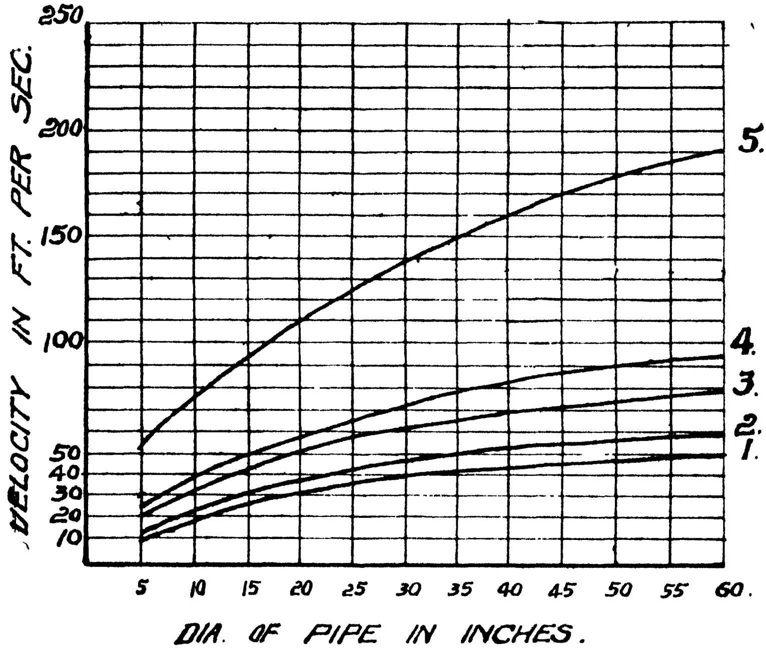
It is said that a company with a capital of two million roubles (£316,666) has been formed by a syndicate of merchants and manufacturers in Tomsk for the purpose of starting sugar beet cultivation and beet sugar manufacture in that district of South Siberia.

Vapour Piping of Vacuum Evaporators, Pans, and Stills.

By GAVIN ALSTON RENTON.

The curves shown in the accompanying diagram may prove useful to many readers of the *International Sugar Journal.* They have been used extensively in practice by the writer, and give good practical results for vapour piping bores in these vacuum units.

In fixing the vapour pipe bore from a single pot or pan working direct to the condenser, curve *5* must be used. For the piping of a double effect, curves *3* and *5* are employed, for the connecting and condenser piping respectively. For the piping of a triple effect use curves *2*, *3*, and *5*; while for the piping of a quadruple curves *1*, *2*, *4*, and *5* are employed.



Example.—Find the respective bores of the piping in a triple effect of 9000 sq. ft. heating surface, working at vacuums of 5 in., 18 in., and 27·5 in. of mercury, and with say 8 lbs. evaporation per sq. ft. per hour.

$$\text{Heating surface per vessel} = \frac{9000}{3} = 3000 \text{ sq. ft.}$$

Total evaporation per vessel in lbs. per second, assuming equal loading,

$$\frac{3000 \times 8}{3600} = 6{\cdot}66 \text{ lbs. per second.}$$

Vessel.	Vacuum.	Sp. volume of vapour in cub ft	Cub. ft per sec. (Sp. vol. × 6·66).	Curve.	Vapour pipe, inches in diam.
1	5	31·3	208	(2)	28
2	18	63·0	420	(3)	34
3	27·5	282·8	1890	(5)	45

Assume a pipe 28 in. bore for the first vessel. From curve *2* we find this diameter conforms to an effective average velocity of 48 ft. per sec. We have 218 cub. ft. to handle per sec. (*see* table), hence area of pipe $= \frac{208}{48} = 4{\cdot}3$ sq. ft.; and the pipe diam. = 28 in., agreeing with the size assumed. Thus the piping leading from the first vessel is 28 in. diam.

Similarly the piping from the second and third vessels is found to be 34 in. and 45 in. bore respectively, by using curves *3* and *5*.

To some engineers the piping may seem of large bore, and the velocities in certain instances low, but large bore piping is a magnificient asset to the good working of vacuum units.

Filtration.[1]

By C. D BURCHENAL.

Filtration is the separating of suspended matter contained in a liquid from the liquid itself, by a process of screening, but the term "filter" is often applied to contrivances operating on the principle of the centrifugal cream separator, the charcoal cell, or the cider-mill, which in reality are, respectively, a decanter, a decolorizer, and a press.

True filters may be broadly divided into three classes depending upon the filtering medium employed; those employing detached particles, those employing a continuous, porous material or fabric, and those employing both. Each of these has its advantage in certain industries and there are many forms of each class differing mainly in their methods of cleaning.

The problem of filtering juices in a raw cane sugar factory, with which we have to deal, is one of the most difficult. The handling of the decanted juice after settling is comparatively simple, carrying as it does, a small amount of suspended matter which may be thrown away when it has been filtered out, so that any form of the detached particle class of filter may be used. But in the design of apparatus for filtering the settlings or *cachaza* the following features must be considered:—Saving of the filtrate; saving of the cake; washing and drying of the cake; conservation of heat: removal of cloths for cleaning; minimizing of labour cost of operation; minimizing of cost for filtering medium; minimizing of up-keep cost (rubber gaskets, sagged side bars, broken plates, etc.).

Supposing we have several different types of apparatus in which all the above features have been taken care of, at the same initial cost. The most desirable one of these is not necessarily the one with the largest filtering surface, but *the one which removes the greatest quantity of cake*, washed to a minimum sucrose content, with the smallest quantity of water, in a given time, at the smallest operating cost and keeps on doing it throughout the season.

Since its invention by DANEK, some forty years ago, the filter-press has been the most successful and widely used form of filter, particularly for handling settlings.

The term "filter-press" by the way would seem to be a misnomer, for the apparatus is primarily a *filter*, the press part of it being merely a means of holding the parts together and exerting no pressure whatever on the material being handled. Common usage has made the term apply to any filter of separable elements wherein the parts are held together by the pressure of a screw or ram.

---

[1] A Supplement to the Report of the Committee on "Manufacturing Machinery" of the Hawaiian Sugar Planters' Association. Issued December, 1916. Here slightly abridged.

With a machine of such a multiplicity of parts as the filter-press, the amount of labour required is necessarily large, but its simplicity and the accessibility of the filter cloths have caused it to endure in spite of the high labour cost for operation. During recent years several efforts have been made to reduce the labour by substituting for the filter-press a modified form of Taylor bag filter, wherein the bags or filtering elements are permanently mounted in a frame with permanent outlet connexions for the juice, and the frame enclosed in container; the idea being that when the cake has been formed on the bags the frame may be removed from the container (or the container from the frame) and the entire charge of cake will be dropped in one operation.

This appears to be a great saving and, after reports of its successful operation on mining sludges and beet juices, it was a source of keen disappointment to the writer in failing to secure equal results with the *cachaza*, for it was found on opening the press that the heavy deposit of cane wax and gums on the cloth had glued the cakes to the cloth with such tenacity that it was impossible to make them drop off and it required a great deal of labour with narrow wooden spades to get the cake out from between the bags.

The labour of spading out the cakes has caused a new form of this apparatus to appear, wherein the spading is done mechanically by spades or ploughs fixed on the inside of the container so as to bear against the filtering surfaces, and filter elements which are circular are mounted on a hollow shaft extending outside of the container through a stuffing-box and revolved by gears. But as the filtrate discharge from all filter elements is through this hollow shaft, it is impossible to detect or shut off the discharge from a leak in a cloth without shutting down the whole apparatus.

Another difficulty experienced with this type of filter was that the cake at times would deposit more rapidly between some elements than others and would build up with such force as to bend the two elements apart, for they consist only of a light frame of expanded metal or mesh, of sufficient strength only to distend the bag and are generally supported at one point only—the outlet connexion. Extra supports at the opposite end of the element were tried, only to find that the element then bent between the two supports.

The bags in this type of filter are sewed on to the frames and cannot be removed for washing, the scheme for cleaning them being to apply water under pressure on the inside of the bag and wash them in place. But when the pores of the cloth are impregnated with cane wax and gums, effective washing cannot be done this way any more than the domestic washing can be done by hanging clothes on the line and turning the hose on them. Nothing short of the manipulation of the fabric in running hot water, such as is accomplished in a laundering machine, will suffice.

To save the labour of cutting, fitting and sewing of new bags on the elements when they have worn or rotted out, and to insure against breakage, various forms of metallic cloth have been employed in this type of filter and have met with considerable success where cakes are to be formed of sludges or other non-fibrous material. The resistance to the flow is greater through such a cloth due not only to the lack of porosity of the threads themselves, but each of the interstices forms a rigid metallic rimmed orifice where each particle of *bagacillo* has the opportunity to display its well known tendency to become tangled and wedged. How well it succeeds may be judged by the "fuzzy" appearance of the cloth after "cleaning." To overcome this, a "cloth" has been devised which may be subjected to high pressure steam for the purpose of blowing out the wedged particles. It consists of two thicknesses of fairly heavy perforated plate, so placed that the perforations are staggered, and the plates then spot welded together at intervals, the idea being that the capillary space between the plates shall form the filtering orifice, with sufficient strength to withstand high pressure steam. The disadvantage of such a "cloth" is its small percentage of aperture, for the total opening obviously can never be greater than the number of holes in one plate × the length of the periphery of the hole × the capillary distance which varies from about 5/1000 of an inch to zero.

It is true that the gumming of the cloth may be prevented to a great extent by adding to the *cachaza* some porous substance, such as kieselghur, for the purpose of absorbing the gums, and excellent results have been obtained by its use, but while it makes the washing of the cloth less frequent, the necessity of getting at the cloth still exists.

It is mainly this same difficulty that makes any form of "continuous" filter unsuitable for work with *cachaza*, though in working cyanide and flotation sludges, several forms of rotating element, "self-cleaning" filters have been used with success.

From the above experience the following conclusions are drawn regarding the ideal filter: the elements must be separable, they must have strength and rigidity, and the cloths must be readily removable for thorough cleaning, and be easily replaced.

Within the last four years the field has been entered by a new machine to which the term filter-press may be truly applied, for it is mostly press and very little filter. Its operation consists in suspending a large cloth bag between two heavy vertical plates of cast-iron, filling the bag with *cachaza*, sealing its mouth and squeezing it between the plates by means of hydraulic pressure. After washing the cake, by passing water through the plates, the juice pan is moved from below the plates, the press is opened and the bag with its contents is dropped. It is then only necessary to get the cake out of the bag, carry the bag to the top of the plates, suspend it between them, replace the juice pan, and the bag is ready for refilling. It is evident that this cycle of operation must be gone through for each bagful of *cachaza* (not of cake) though it is said that recent improvements have arranged the press for squeezing three bags at a time with grids between bags to form outlets for the juice. This, however, would seem to offer difficulties in washing the cake contained in the middle bag, which is not in contact with either plate.

This machine is said to have given excellent results in extracting juice from grape pulp, and in the solidifying of sewage for fertilizer, but how far it will reduce the labour cost per ton of cake filtered from *cachaza* the reader may judge for himself.

In designing this machine the idea seems to have been that mere pressure would solve the filter problem, while in reality pressure is not to be desired, and if filters could be practically operated on no more pressure than a slight gravity head, a better juice would be obtained, and more of the gums and substances detrimental to crystallization would be retained in the cake instead of being forced through the cloth by the increased pressure.

The cake chamber of the ordinary plate and frame filter is a compartment, the sides of which are formed of cloth supported on the outside by projections cast on the plates. When the liquid first enters it passes through the entire surface of the cloth into the space behind it and is drained off at the outlet as fast as it can flow through the outlet cock. But as the cloths become coated and the pressure increases, the cloth is pressed against its supporting projections with such force that the filtering surface is decreased by the amount of area of the supports. As the pressure is further increased, the cloth stretches and sags between the supports until it rests against the web of the plate itself, so that more and more of the filtering surface is blocked, until most of the flow of juice is down through the cake already deposited and out through the cloth at the corner nearest the outlet.

A careful examination of any hard filter cake will prove the existence of these conditions, by the stratified character of the cake in the outlet corner, and the convolutions on the sides of the cake which will show a depth equal to those on the plate. In the earlier filter-presses, the supporting projections on the plate were cast in the form of ridges, arranged in herring bone and other patterns, but in later forms these ridges are cut up into a series of separate pyramid-like projections, so that the area of the cloth which is blocked off by the supports is greatly decreased, with consequent better results.

Supporting the cloth on perforated plates was tried in some of the early types of filter, but this was abandoned on account of the small percentage of aperture area which was no better in its results than the ribbed plate.

From this experience, a fourth conclusion may be drawn regarding the ideal filter, viz : The area of the supports for the cloth must be as small as possible and provision must be made so that the cloth can not be pressed against the web of the plate.

After a comprehensive investigation of many types of filters of both domestic and foreign manufacture, it was thought that an apparatus could be designed which would embody the four foregoing fundamental conclusions, at the same time doing away with many defects to be found in existing filters, and to this end the writer, working in collaboration with Mr. J. P. Foster of the Maui Agricultural Co. and with the assistance of Mr. L. Hebert of the same company, has developed an apparatus known as the Fohebur Filter, which, from tests made at the plantation, seems to realize all that was hoped for.

The Fohebur filter is an improved type of plate and frame filter-press wherein the efficiency of the cloth is increased by supporting it on a double crimp wire-woven screen carried on ribs cast on the plate, to which the screen is secured. These ribs are continuous, extending diagonally across the plate (in opposite directions on opposite sides), adding greatly to its strength and allowing a lighter plate to be used than one where the surface is formed by a series of pyramidal-like projections, and is of equal strength.

The same pattern is used for both sides of all plates, so that all are symmetrical and exactly alike. There is no grouping to be followed in their arrangement such as with the one, two, and three " button " elements in the ordinary washing press, where it is necessary to cut out a whole group should one plate be broken.

The liquid to be filtered enters the press through two holes in the upper corners of each plate and frame, which form two inlet headers. These are open only to the frames and at their highest point, providing liberal inlet capacity and enabling one header to be used as an air vent when filling the press with unfiltered liquid through the other inlet header, so that filtration starts at once through the entire area of the cloth. This also permits the admission of air or steam at the *top* for driving ont the liquid through outlets at the *bottom* and drying the cake.

The plate is made so that the filtrate on opposite sides of it is kept separated, each side having an independent outlet at the bottom of the plate and on the opposite side of the press to that of the other. This makes it possible to shut off the discharge from the cloth on one side of the frame in case of a leak and yet allow the cloth on the *other side of the same* plate to continue in use.

From these outlets the liquid passes out through a combination sight-glass and cock, and back into the plate through a channel cored in through the edge of the plate to a hole running transversely through the plate, which, when the press is closed, registers with corresponding holes in the frames and cloths, forming an internal outlet header on each side of the press, extending its full length to the press-head where a double pipe connexion is made, one connexion to the clear filtrate receptacle and the other from the wash water supply.

The use of a sight glass, so that leaks may be detected and shut off, makes it practical to employ the internal outlet header, which does away with the old-fashioned open gutter with its tendency to catch pieces of cake during the cleaning operation, and the loss of heat due to the open discharge. The elimination of the gutter also enables the operator to stand closer to the press when cleaning it, and makes it possible for the press to be mounted close to the floor, with consequent cleaner discharge of cake into the hoppers.

The double pipe-connexion to these outlet headers allows either or both sets of outlets to serve a double purpose; either being used as an outlet during filtration, and as an inlet for water during the washing of the cake. It also allows the reversal of flow of the water through the cake during the washing operation, by admitting the water through the opposite header.

The use of two outlets from each plate increases the speed of the filtering operation, for until the deposit on the cloths becomes excessive, the discharge of filtrate is limited. in the ordinary filter-press, by the size of the outlet. Due to the more rapid filtering by the supported cloth and the greater facility in washing, the frames are made three times as deep as those in the usual press, thus increasing the cake capacity for the same size press and reducing the amount of cloth required per ton of cake to less than half the usual amount.

The frames are made rectangular so that they may be each dressed with one length of cloth, utilizing the full standard width with no cutting or waste except for the holes at header openings.

By eliminating the separate washing header and locating all inlet and outlet headers within the rectangle covered by the cloth, all joints are made by the cloth itself, thus doing away with rubber collars and troubles arising from their deterioration by heat. All joint faces are made wide to decrease the wear on the cloth, and those faces around the outlet headers are extra wide to allow for inaccuracies in the location of holes in cloths due to shrinkage or expansion.

The plates and frames are arranged by means of rollers, to move easily along the side bars, and are made as large as two men can operate conveniently so as to get the greatest capacity at no greater labour cost than is required for the smallest press; the greater depth of frames also decreases the number of units to be handled.

The press is closed by a hydraulic ram, and when the required pressure is once attained the ram is mechanically locked in position, so that it is not necessary to maintain the hydraulic pressure, and no accumulator is required. A small hand pump mounted on the press stand enables the two operators to attain the requisite pressure, or it may be power-driven if greater speed is desired.

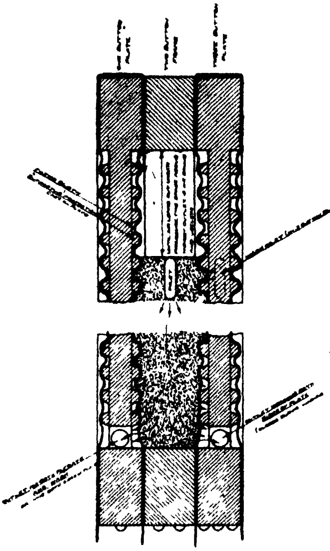
The locking is accomplished, when the ram is in its outward position, by screwing backward a large lock nut, threaded on to the ram, against a thrust block between the lock nut and the yoke of the press. Unlike other devices of this kind, this thrust block swings in a plane perpendicular to that of the ram, so that it may be swung clear as soon as the pressure is taken on the ram and the lock nut is merely loosened. It is cast in halves, and when in position forms a cylinder enclosing the ram.

The follower plate of the press carries the usual thrust block, balanced so that it may be swung out, giving a quick opening of the press. It is carried on flanged wheels running on the side bars of the press, with hand wheels at the ends of the wheel shaft, so that it may be easily moved by hand.

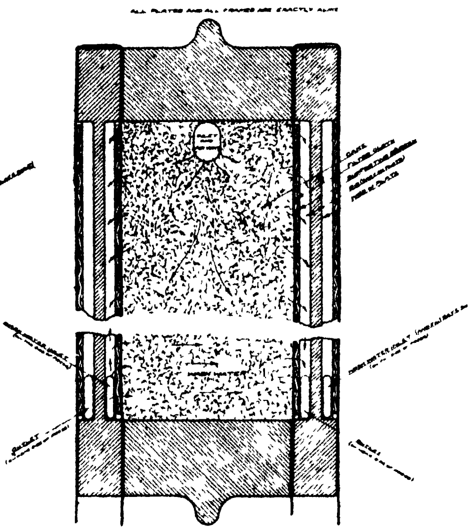
In cleaning the press, the follower is first run back, the first frame dumped and moved up against it, the first plate moved up against the frame, the second frame dumped, and so on, until all the elements are stacked against the follower in its backward position. All the elements are now pushed forward together by the ram, up against the head of the press, and with the ram locked in place, the press is ready to fill again.

Thus the elements are "dressed" as fast as they are dumped and are only handled once by hand, half of the work being done by the ram.

This type of press is especially adapted for use with kieselguhr as the free-filtering quality which this material gives to *cachaza* enables advantage to be taken of its ability to form thick cakes in a comparatively short time without unduly high pressure.



Section of Chamber in Usual Filter-press showing forming of Cake under Pressure



Section of Chamber in Fohebur Filter-press, Upper Part showing Filtration and Lower Part Method of Washing.

The accompanying diagram shows vertical sections of two filter-press chambers. The first figure illustrates the sagging of the cloth described above, as well as the stratified form of the cake at the bottom. It also shows the air pocket formed in presses where the inlet header is not located at the top of the frames, though this has been obviated in some cases by the use of a pet-cock on the top of each frame. The second figure is a section of the Fohebur chamber showing the perfect support of the cloth and the ample draining space behind the cloth, on both sides of the cake. It also shows the free passage for wash water from the entire surface of the cake, and shows how the air vent at the top of the frames permits them to be entirely filled and the whole of the cloth utilized from the start.

Experiment Station Enterprise in Java.

In a private communication received by the editors of the *Journal of the Board of Agriculture of British Guiana*, Dr. J. KUYPER, formerly Government Botanist in Surinam, gives the following interesting information regarding the organization of the sugar cane experiment stations in Java to which he has recently gone.

These stations, of which there are three—chemical, technical, and agricultural—were started and are supported entirely by the planters themselves, and are quite independent of the Government. Dr. KUYPER deals with the agricultural department only, with which he is personally connected, and leaves it to be surmised that the other two bureaux are organized in a similarly complete fashion.

The agricultural station is at Pasoeroen and has a Director and an Assistant Director, who are both graduates (Ph. D.) in Botany. The Director concerns himself especially with general questions such as meteorological and climatological influences on cane cultivation, the fitness of special districts for cane, and so on, and receives reports from his officials who are spread over a district covered by ten estates. These officials have what Dr. KUYPER calls a "lower education," but are qualified to help the managers in making experiments and to send in to headquarters at Pasoeroen every kind of particular about their district. They are termed "groeps adviseurs." All the experiments are, however, planned by the Director or his Assistant, who draw their conclusions from them.

Next to this section, and quite apart from it, is the strictly scientific department, which is engaged in collecting purely scientific data. There is a Ph. D. in Botany for crossing and selection, and another (Dr. KUYPER) for plant physiology; two bacteriologists (from the Technical University at Delft) for soil bacteriology and a chemist for soil analysis—all with high degrees. In addition to his scientific work, Dr. KUYPER occupies himself with the further education of the "groeps adviseurs." He travels round the estates, visiting each "groep," listening to their difficulties, giving them directions, and explaining the object of each experiment and what it is hoped will be learned from it.

With this splendid organization, it is not surprising to learn that large profits are made in the sugar industry in Java. This past year the crop has been a big one, prices have been high, and some estates have made a profit of from one to two million guilders (12 guilders = £1). Some of the Java varieties give about 6 tons (6000 kg.) of sugar per acre. Evidently the Dutch planter believes in Science as an adjunct to business, and is not afraid to back his opinion.

The new process for the manufacture of phosphoric acid,[1] suggested by chemists attached to the Bureau of Soils, Washington, is to be tried by a firm in Hoboken making baking powder, and the Bureau is at present engaged in aiding the company in the erection of the necessary plant.

Replying to a question in the House of Commons last December, the Parliamentary Secretary to the Food Board pointed out that the substitution of glucose for sugar as a food would only result in more bulky materials having to be imported for its manufacture than was the case with sugar, so that there was no advantage in encouraging its consumption. The possibility and desirability of extending the use of saccharin for flavouring purposes would be considered, but it was to be observed that saccharin has no food value.

---

[1] *I.S.J.* 1916, 569.

British Colonial Reports.

BARBADOS.

The seedling sugar cane, B 6450, to which reference has been made in the last three annual reports, has continued during 1915-16 to give excellent results as compared with the White Transparent and other varieties that have been cultivated for some years. The Barbados Department of Agriculture reports that for the 1915 crop the average yield of this variety over large areas exceeded that of the White Transparent, the standard cane, on the average of both plants and ratoons in the black and red soil districts, by 8·7 tons of canes per acre, and in spite of comparatively poor quality of the juice, due to the excessive rainfall during the reaping season which prevented the canes from ripening properly, by over half a ton of dark crystal sugar per acre. Further, that the monetary gain to the planters, had the whole 30,000 acres been planted in this variety, would, at the average price at which sugar sold during the ten years previous to the outbreak of the war, have been not less than £160,000. Other new varieties, notably Ba. 6032 and B.H. 10 (12), have, during the period under review, given excellent results, and plants are now being distributed to the estates for cultivation in considerable areas. Of the former over 1000 acres have been planted for the crop of 1917. During the crop of 1915 the experimental trials with the Ba. 6032 on nine estates resulted, on the average, in an increase over B. 6450 of 1334 lbs. of saccharose per acre.

Of 291 sugar works in the island, 102 were equipped with steam machinery. There is a tendency generally towards the erection of improved machinery on sugar estates. Improvement in this direction, however, has been retarded on account of increased difficulty in obtaining material, owing to conditions resultant on war.

185,952 gallons of rum were manufactured in the island as compared with 235,049 in 1914, showing a decrease of 50,097 gallons.

LEEWARD ISLANDS.

The rainfall for the year 1914-15 was below the average in both Antigua and St. Kitts, while its distribution was very unfavourable, a fairly satisfactory rainfall in the early months of the year was followed by a prolonged spell of dry weather during the months of August, September, and October, which had the effect of checking the growth of the cane crops during their most critical period of development. In consequence the yields of cane in both places were low and the quality very indifferent.

The exports of sugar for the two sugar-producing Presidencies were made up as follows:—Antigua—Grey crystals 86 per cent, and muscovado 14 per cent. St. Kitts-Nevis—Grey crystals 77 per cent and muscovado 23 per cent. The amounts were as follows: Antigua, 10,779 tons; St. Kitts-Nevis, 8,246 tons; total, 19,025 tons. In addition, Monserrat exported 37 tons

At Gunthorpes Factory in Antigua 8391 tons of sugar were produced, the recovery per cent. on the indicated sucrose being 10·29. 2220 tons of peasants' canes were purchased by this factory during the crop under the terms of the original agreement, whereby a grant of £15,000 in aid of its erection was made by the Imperial Government. The extension of the factory railway lines to include a number of additional estates on the windward coast of St. Kitts enabled the Basseterre sugar factory to extend its operations during the year under review. Had it not been for this extension, the crop would have been decidedly smaller.

Throughout the year sugar prices ranged round values which were considerably in excess of the average for a number of years previously; consequently, in spite of the poor yield, satisfactory results were experienced by the majority of sugar estates in the colony.

It would appear that it is not the present intention of the Royal Commission for Sugar Supplies to apportion any of the present year's sugar quota towards meeting the needs of amateur jam makers. These latter will probably have to depend on what they can save out of their ordinary purchases. The Commission will only consider the claims for such sugar as come from the professional preserve manufacturers.

Correspondence.

CONDENSING SYSTEMS.

To the Editor "The International Sugar Journal."

Sir,—In the December issue of the *International Sugar Journal* Mr. Ed. Koppeschaar brings up a very interesting point in connexion with condensing apparatus, but it would be instructive to know what type of condenser he refers to under the paragraph describing "(*b*) method."

Here it is said that the extra pressure will ensure greater speed to the flow of water, and the quantity needed will be correspondingly smaller.

In practically all cane sugar-house condensers of the barometric type, the flow of water once in the condenser is governed by the action of gravity directly it is on the top plate.

Speed or velocity given to the water in any case, cannot, without great sub-division, be of value at all, once the vapours are in contact with it

Could Mr. Koppeschaar give some data regarding temperature of ingoing and outgoing water with corresponding vacuums obtained, and the barometer reading of the day when the trials were made?

Should these be available, some very interesting information would come to light on the problem or, as that gentleman puts it, this more or less unknown branch of sugar technology.

Yours faithfully,

Frank Coxon.

To the Editor "The International Sugar Journal."

Sir,—In an article by Mr. Koppeschaar, in the December issue of your Journal, figures are given to show that poor vacuum results in allowing condensers to draw the injection water by vacuum, through increased work being thrown on the air pump.

That the "work" on the air pump is unaffected, however, may be readily shown. The work depends on the weight of air removed, which latter is derived from the steam and the water. The ingoing water displaces its own volume of air and increases the work of the pump to that extent, but this is negatived by the same volume of water falling away through the tail pipe, so that, unless more air enters with one system of injection piping than another, the amount of air and, therefore, the work of the pump is unaltered.

The fact remains, however, that less vacuum was registered. The explanation will probably be found in air leaks in the suction pipe joints, at the pipe entrance, or at the spindle of the injection valve. A small leak through lack of a water seal would account for the difference noted.

Yours,

Jas. Hamill.

To the Editor "The International Sugar Journal."

Sir,—Mr F. Coxon gave some interesting practical notes in his paper on "Sugar-house Condensing Systems," published in last month's issue.

With regard to the suction pipes for dry pumps a statement is made and figures given for the ratio of expansion, and these are merely based upon Boyle's law, i.e., constant temperature. This is surely very badly out since such expansion would certainly conform to Charles' law; the volume being proportional to the absolute temperature.

The final statement that "the volume of air to be extracted will be ten times the displacement of the pump" is of course a clerical error.

With reference to Mr. J. Hamill's notes upon "Air in Condensers," I would like to make some remarks about obtaining temperatures. It is very difficult indeed to measure with any pretence of precision the temperature of such a mixture, and this is certainly not understood by the greater bulk of engineers.

When wet steam impinges upon a thermometer bulb, the ensuing adiabatic compression of the fluid produces a rise in temperature. This rise is quite appreciable, and it goes to show that great care must be taken in such work to cope with unforeseen events. The principle applied is known as Dalton's law, and is an interesting feature with regard to steam heated calandrias. It is known that Gay Lussac and Dalton had a difference over the combination of gases, and so the future may yet have a surprise in store with regard to this theory.

Yours sincerely,
Gavin A. Renton.

90, Westmoreland Street,
Govanhill, Glasgow.

AMERICAN v. BRITISH MILLS.

To the Editor "The International Sugar Journal."

Sir,—As a West Indian colonist and sugar planter of many years' standing, I have perused the article under the above heading in your widely-read Journal for the current month, with much interest. I have also carefully read the extract from the report of Mr. Girard Harris, the United States Special Agent of the Department of Commerce, together with your comments on same.

Now as regards Mr. Girard Harris' report, it seems to me to be a very fair résumé of the comparative values of sugar mills produced in the United Kingdom and America, and I am at a loss to understand why, if one country surpasses the other in this special branch of engineering, it should cause such indignation and heartburning, as your article suggests.

Every good sportsman takes the decision of an umpire or referee with perfect equanimity, and it appears that Mr. Girard Harris is, metaphorically speaking, in the position of a referee in the matter.

Without doubt British manufacturers have had on many occasions to give way to other countries in respect to cheapness, time of delivery, and possibly terms of payment; but, as far as I am aware, they have never had to take a back seat where the quality and durability of their goods are concerned.

It is refreshing to find that as an independent and unbiassed official, the American agent has been so outspoken in his remarks, and although it may not be considered pleasant reading by the American sugar mill makers, it was no doubt intended to act as an impetus to them to further improve their productions, for which improvement, according to Mr. Girard Harris, there is still room.

With the exception of in Cuba—which island has special reciprocity arrangements with the United States—and in the island of Porto Rico, which levies a 45 per cent. import tax on foreign goods, there can be but few American sugar mills in the whole of the West Indies. I know that some 14 or 15 years ago an 11-roller mill was supplied by an American firm for a large sugar plantation in Demerara, but this is the only mill of American manufacture in the British West Indies of which I am cognizant. One cannot help commenting on such a very significant fact.

It is regrettable that the Fulton Ironworks representative—quoted in your article—should suggest that there is any antipathy or racial prejudice existing in the British West Indies regarding American goods. He has evidently never been there, or he would not have made such an unwarranted remark, and the least said about it the better. Also I do not know how he reconciles himself to making this statement, seeing that the West Indians are such very large customers for many classes of American machinery, food stuffs, and general merchandise of every kind.

I am, Sir, yours faithfully,
F. I. Morris.

West Indian Club,
London, 31st January, 1917.

To the Editor "The International Sugar Journal."

Sir,—May we say a few words in connexion with the storm created among sugar engineering firms by Mr. Girard Harris' report *re* the "Derby" mills?

The report referred to was made for the use of commercial men of the United States, and this being the case there can be no reason why Mr. Girard Harris should be attacked by American engineers, simply because he gives the bona-fide result of his enquiries.

Above everything else in this controversy looms the solid fact that there is only one American mill in the British West Indies—erected about 15 years ago. That two more have been recently ordered from the same source is due to the difficulty of obtaining delivery in war time from British manufacturers, who are at the present moment executing orders for mill plants to the best of their ability in the exiguous circumstances.

One of our travelling representatives informs us that he has not, in the course of a recent visit to the principal sugar-making centres of Brazil—a country which has no particular commercial association with the United Kingdom—come across a single American mill in any of the important plantations he has visited. In Peru there is, we believe, only one American mill of any importance at work.

Yours faithfully,
George Fletcher & Co., Ltd.,
Derby. R. G. Finney, Managing Director.

Review of Current Technical Literature.[1]

Curing of Low Grade Massecuites. *J. H. Pratt. A Paper read before the Hawaiian Chemists' Association, November, 1916.*

In the last few years there has been a considerable increase in the extraction obtained by a majority of the mills in the Hawaiian Islands, and while the economically profitable limit may have not yet been reached, there is no doubt that this higher extraction is attended by a slightly larger proportion of impurities in the juice that is delivered to the boiling-house. Furthermore, the weight of cane handled per hour (and consequently the amount of juice, syrup, massecuite, etc.) is increasing each year often without a corresponding increase in equipment necessary to handle the same. The question of curing the massecuite is therefore becoming more important yearly. Curing is, of course, only one link in the chain of sugar manufacture, and is influenced to a great extent by the manner in which the preceding operations have been carried out. That "a chain is no stronger than its weakest link" is as true of a sugar factory as of anything else. If the juice has been clarified, and the massecuite boiled as well as possible, the question of curing will not present the serious problem that it will if a factory has a poor clarification system, or where from lack of sufficient capacity the centrifugal, pan, or other work must be rushed at top speed to keep the house from becoming blocked.

While curing includes several distinct operations, the method of hastening the drying of low grade massecuites will alone be considered. These may roughly be divided into three main heads:—(1) Treatment of the massecuite before it enters the centrifugal; (2) Treatment of the massecuite in the centrifugal; and (3) Treatment of the molasses before boiling low grades.

(1) *Treatment of the Massecuite before it enters the Centrifugals.*—The oldest method under this heading consists in thinning the magma in the crystallizers with water or other diluents. The usual practice is to boil the strike very stiff, and later dilute the molasses surrounding the sugar crystals until the massecuite has reached a definite degree Brix. Of course, extreme care is necessary to prevent the dissolving of any grains of sugar. Some places use final molasses for this purpose, the details varying; some heat the molasses, others use it cold; some dilute the molasses before heating, others do not. With a very gummy massecuite, a dilute solution of caustic soda gave very gratifying results as far as

---

[1] This Review is copyright, and no part of it may be reproduced without permission.—(Editor, *I.S.J.*)

the time of drying was concerned, but was not continued on account of too great a rise in purity of the resulting molasses.

One factory warms the massecuites from the low grade tanks by putting them in a jacketed crystallizer (heated by exhaust steam or by the condensate from the evaporators and pans) for a few hours before they go to the mixer. Other plantations accomplish the same results by the use of hot water or steam in the mixers themselves. This is generally reported as giving good results, although in one place the saving in time was offset by the rise in purity of the molasses, as shown by the following average figures of a number of trials:—

	Time of Drying.	Temperature of Massecuite.	Molasses		Sugar Polarization.
			Brix.	Purity.	
Heated	48 mins. ..	37·0°C ..	89·53 ..	35·02 ..	78·20
Not heated	63 ,, ..	30·1°C ..	89·20 ..	33·63 ..	75·48

(2) *Treatment of the Molasses in the Centrifugals.*—The time-honoured method of hastening drying under this head is by the use of steam. The steam has been used both inside the basket and the outer casing, but the latter method is by far the most common, as there is considerably less danger of the destruction of sugar. To prevent the eating away of the basket, it is suggested "to discharge the steam between the curb wall and the centrifugal basket, a plate fastened to the curb wall throwing the steam in the same direction as the revolving centrifugal, thereby saving the basket from being cut by the steam jet. The effect of this steam on the purity of the molasses is very small." A test showed a saving of 10 to 20 per cent. in time, an increase in purity of 0·1° of the molasses, and an increase in polarization of the resulting sugar of 4°, due to the use of steam.

The "hot molasses method" is thus described: "To hasten the drying of low grade sugars, start the centrifugals empty. After it has gathered enough speed to prevent swinging, the massecuite is run in slowly, the hot molasses (180° to 190° F) flowing in at the same time through a ¾ in. pipe, three-quarters open or more. The outlet of this pipe is placed just above the drip pan, almost touching and in front of the inflowing massecuite. The molasses should not be thinned by wash-waters, or there will be loss through rise in purity of the molasses. Even with this precaution there may be a rise, but not enough to offset the great gain in time of drying." The time of drying has in instances been cut down to half; the sugar had a polarization of 81°, as compared with 68° where no hot molasses was used; and the molasses discharged from the machines had about the same purity.

(3) *Treatment of the First Molasses before boiling the Low Grades.*—This method depends on clarifying the first molasses with syrup and separating the impurities by means of centrifugal action. This has been successful in one mill, but the method has not been generally adopted.

X.

Extraction of Sugar from Low Grade Molasses by the Williams Process.[1] *J. N. S. Williams. Report to the Hawaiian Sugar Planters' Association, 36th Annual Meeting, 1916.*

During the year 1914 it was discovered that if final molasses of 30 to 32 per cent. sucrose and 35° to 37° purity be boiled to a complete or almost complete absence of water the sucrose contained therein crystallizes out in a very small but perfectly shaped grain. This being contrary to the generally accepted theory of the time, several tests were carried out on molasses of this grade from different plantations in Hawaii to determine whether the phenomenon was of general application, and the final results of these tests lead to the belief that it is a correct statement to say that the sucrose in all final molasses produced in the territory will crystallize out in a grain that is visible to the unaided eye if the molasses be evaporated to a density of say 99° Brix at ordinary temperatures.

---

[1] See U.K. Patent, 16,799 of 1915; *I.S J.*, 1916, 577.

This point having been determined, a great deal of work was done to ascertain whether the small grain so produced can be recovered by mechanical means in such quantity and at such cost as would render successful a process for its recovery. Hence, in the summer of 1915, an experiment on a practical scale, using a 30 in. high-speed centrifugal having a solid basket and operating at a very high speed of revolution, was carried out, and it proved beyond a doubt that the very dense and practically solid molasses containing crystallized sucrose could be separated into two parts, one containing a major portion of glucose, gums, etc., and a minor portion of sucrose, while the other contained a major portion of sucrose with a minor portion of glucose, gums, etc. This experiment showed that over 45 per cent. of the sucrose present in the original final molasses which had a purity of about 40° was recovered in the form of a massecuite having a polarization of 50 per cent. and a purity of 53°.

In order to determine whether or not, after the recovery of the sucrose had been effected as described, it could be converted into a marketable sugar, arrangements were made with the Laupahoehoe Sugar Company, and during the 1916 crop a quantity of final molasses was boiled to a practical absence of water, and run into small containers for the sucrose to crystallize. At the close of the crop an apparatus for reducing the solidified molasses to a magma that would flow, together with a special 30 in. high-speed centrifugal for separating the material, was installed and a quantity of purified massecuite, sufficient to make a small strike in one of the vacuum pans, was produced. This strike was boiled to string-proof and run into coolers. After some 10 or 12 days' standing in the coolers, the massecuite was dried in an ordinary 30 in. Weston centrifugal, and a low grade sugar was produced.

Thus, from a so-called "final molasses" having an apparent purity of 35°, a massecuite having a polarization of as high as 58 per cent. and a purity of as high as 64° was produced, with a waste molasses having a polarization as low as 22·5 per cent. and a purity of 27·73°.

It is claimed that the following can be stated to have been demonstrated:—(1) That what is commonly called "final molasses," when boiled to say 99° Brix will develop a very small grain representing practically the whole of the sucrose present in the molasses; (2) that this grained sucrose can be recovered in large quantity when suitable equipment is provided; and (3) that this recovered sucrose is convertible into a marketable product.

Given a properly designed and operated equipment the cost of recovering the sugar should be no greater than the cost of recovering third or fourth sugars as now carried out. All the operations are mechanical, there being no special skill required in boiling the molasses to 99° Brix, and one man could attend to a number of the centrifugal machines.

It appears to be fully proven from the results that have been obtained that it is not the glucose, gums, or ash in the molasses which, either singly or in combination, prevent the sucrose therein from crystallizing, *but solely the water present;* and as one part of water will hold in solution two parts of sucrose, it seems clear that a molasses containing any considerable percentage of water cannot be made to yield up its sucrose in any other manner than by removing the water, and thereby allowing the sucrose to crystallize. It seems safe to predict that the recovery of at least one-half the sucrose now lost in the final molasses may be realized in the near future. If this be accomplished, it will mean a gain of over 3 per cent. on the total sugars now manufactured in Hawaii alone.

Mr. Williams also read a memorandum, giving some data relating to his investigations, these being as follows:—After boiling this molasses to practically a complete absence of water, 644 lbs. of solid molasses, of 47·41° purity, were diluted and made fluid with 7 per cent. or 47 lbs. of cold water, producing a massecuite which weighed 691 lbs. This was spun in the high speed centrifugal in four charges, producing a massecuite which weighed 364·5 lbs., being 52·7 per cent. of the charge as introduced into the centrifugal. The recovered valuable massecuite polarized 57 per cent. sucrose, and had a purity of 59·9°. The molasses removed during the operation had the following analysis:—Weight, 326·5 lbs., being 47·3 per cent. of the charge introduced into the centrifugal; Brix, 88·76 per cent.; polarization, 25·62 per cent.; and purity, 28·87°.

Relative Richness of a Few Kinds of Sugar Cane in Queensland, Australia. *Anon. Queensland Agricultural Journal, 1916, 5, 100-101.*

At the request of the Mackay Manufacturers' Association of Mackay, Queensland, the Central Sugar Experiment Station of Mackay in 1913 undertook comparative growing trials and analyses of crops of different varieties of sugar cane cultivated in that district, among which "Cheribon" and "Oramite" form a large proportion of local production, but are not much cultivated outside the Mackay district. Month by month, from June to December, 8 to 14-months-old canes were tested both in 1914 (plant crop) and in 1915 (first ratoon crop). From two tables giving the detailed results there were obtained the averages reproduced in the following table. By early planting is meant planting in March; by late planting, planting in August. It will be seen that in both years the first three varieties clearly surpassed the last three.

	Plant Crop		First Ratoon Crop.			
Varieties	Early Planting Pure obtainable Cane Sugar. Per cent	Late Planting. Pure obtainable Cane Sugar Per cent.	Early Planting Pure obtainable Cane Sugar. Per cent	Early Planting Quotient of Purity. Per cent	Late Planting. Pure obtainable Cane Sugar Per cent.	Late Planting Quotient of Purity. Per cent.
H. Q. 426	15·0	16·6	18·4	91·5	18·8	92·5
Badila	15·1	16·6	19·8	92·6	18·7	91·5
Goru	13·2	13·9	17·0	90·5	16·4	89·0
Cheribon	12·6	12·6	15·6	87·4	15·5	85·6
Malabar	11·8	11·8	15·0	87·8	15·3	86·4
Oramite	11·0	11·4	15·0	88·1	15·0	86·8

Determination of Levulose in Presence of Dextrose. *L. Loewe. Physiological Abstracts, 1916, 1, 79.*

After boiling, and adding a 0·2 per cent. solution of orcein and a 85 per cent. solution of phosphoric acid, a yellow colour is produced, which becomes orange on the addition of alkali. This reaction is made quantitative by colorimetric comparison with a standard levulose solution treated with the reagents under similar conditions. Sucrose interferes, owing to hydrolysis by the acid.

Determination of Pentoses by Means of Fehling's Solution. *J. L. Baker and H. F. E. Hulton. Analyst, 1916, 41, 294-297.*

It is recommended that in Eynon and Lane's method a larger volume than 20 c.c. of Fehling's solution should be used with a proportionately larger quantity of the distillate, in order to increase the weight of cupric oxide obtained, and further, that the flask containing the mixture should be placed in a boiling water-bath for 35 minutes. In this way the amount of cuprous oxide produced by the sodium chloride is diminished considerably, whilst the furfuraldehyde-copper ratio is not affected.

J. P. O.

Review of Recent Patents.[1]

UNITED STATES.

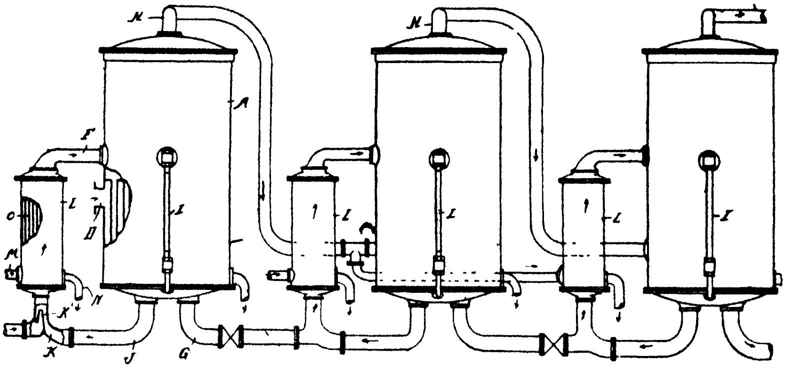
Evaporator, in which the Liquid is Circulated over the Heating Surface.

Léon Naudet, of Chelles, France. *1,190,317.* Patented, July 11th, 1916.

According to the construction described, the efficiency of the apparatus is increased by stimulating a circulation of the liquid in each unit. In other words, there is a constant flow of liquid through the system as it passes from one body to the other, and the force of the moving liquid from each evaporator may be utilized in an injector for saving a larger volume of the fluid and circulating it over the heating surface.

As shown, *A* is the outer casing of one of the units of the multiple effect evaporator, this being divided as is usual by partitions into compartments connected by tubes extending from one to another, the space between and surrounding the tubes constituting the steam compartment, to which vapour is supplied by the conduit *D*, while a conduit carries away the water of condensation. *F* is an inlet conduit for the juice above the partition, and *G* is an outlet conduit which leads from the lower end of the body to the next unit. *H* is a vapour conduit leading to the steam space of the next unit.

The design as above described constitutes a standard construction used in multiple effect evaporators, and its efficiency depends upon the amount of heating surface and the rate of flow of liquid over the same. This may be increased without change in the amount of heating surface by the construction shown, in which *J* is a return conduit connected to the bottom of the tank and leading to the inlet conduit *F*. *K* is an injector connected into the conduit *F*, the nozzle *K* of which forms a jet of incoming fluid which imparts its velocity to a larger jet of fluid returning through the conduit *J*. Thus the rate of flow of the liquid into and out from the tank *C* is greatly increased, which results in a corresponding increase in the rate of flow over the heating surface and an increase in efficiency.



Where it is desired to apply the improvement to a plant already installed, all that is necessary is to supply the injector *K* and the return circulating pipe *J*. If, however, it is desired to still further increase the efficiency or to correct a lack of balance between the units one may employ the construction illustrated. In this modification a small additional vessel *L* is connected in to a vertical portion of the conduit *F* in the circuit formed by the return conduit *J*. Thus the casing *L* is provided with a steam chamber supplied with steam from a conduit *M* and an outlet *N* for the water of condensation. The injector *K* is placed at the base of the casing, and therefore not only the inflowing liquid from the conduit *F* but also the circulating liquid from the conduit *J* is passing through the heater and the small tubes *O* thereof before re-entering the tank *A*. Obviously the amount of heating surface in this auxiliary heater may be readily varied, and in this way any defects of this nature in the original installation are remedied, as well as the efficiency of each unit of the evaporator increased. It is also apparent that the units of a multiple system may be balanced by differentially recirculating the fluid in the units by varying the efficiencies of the injectors *K*.

---

[1] Copies of specifications of patents with their drawings can be obtained on application to the following:—*United Kingdom:* Comptroller of the Patent Office, Southampton Buildings, Chancery Lane, London, W.C. (price, 6d. each). *United States:* Commissioner of Patents, Washington, D.C. (price 5 cents each). *France:* L'Imprimerie Nationale, 87, rue Vieille du Temple, Paris (price, 1 fr. 05 c. each). The date given in the heading of specifications is that of the application of the patent.

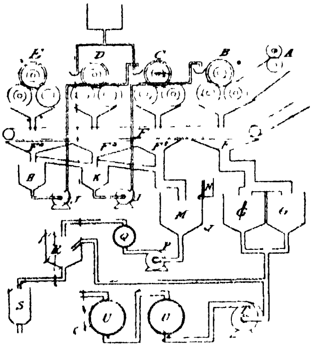
By this method the circulation of the liquid is accomplished without the use of additional force or mechanically-driven pumping or circulating devices. Furthermore, it may be applied to the units which are operating under less than atmospheric pressure without the use of stuffing boxes or other devices for maintaining air-tight joints. In other words, there is nothing to break the seal.[1]

MILLING OF CANE JUICES WITH THE PURIFICATION OF THE SECOND, THIRD, AND FOURTH MILL JUICES. *Harold S. Truscott*, of Makaweli, T.H. *1,177,832*. Patented, April 4th, 1916.

According to the method of operation proposed, the juice expressed by each of the mills is strained separately, and the juice from the second mill, and that from the third and fourth (in excess of that used for maceration) are limed, heated, and subsided. The juice thus purified is mixed with the crusher and first mill juice, preferably after the latter has been limed, and the total mixed juice is clarified in the usual way.

In the drawing, *A* illustrates the crusher rolls, which prepare the cane fed to the first three-roller mill *B*. *C*, *D* and *E* represents the second, third and fourth three-roller mills respectively, which with the crusher and the first mill are arranged in tandem in the usual manner. *F* is the filter or juice strainer employed to screen the juices and separate the particles in suspension in the juices, the screenings being returned to the mill in the usual manner.

The juices expressed by the first mill and the crusher are strained in the forward section F^1 of the juice strainer *F* and passed to the tanks *G* to be limed. The juice from the fourth mill *E* is strained in the rear section F^4 of the juice strainer *F* and passes into a receiving well *H*, from which the pump *J* lifts it to be applied for the maceration of the bagasse from the second mill *C*. The juice expressed by the third mill *D* is strained in the section F^3 of the juice strainer *F*, and passes into the receiving well *K*, from which the pump *L* lifts the juice to be applied for macerating the bagasse from the first mill *B*. The juice from the second mill *C* is strained in the section F^2 of the juice strainer *F* and is passed preferably into a continuous liming tank *M*, which is supplied with milk-of-lime from the tank *N*. Any excess of juice from the fourth mill *E* over that pumped by the pump *J* accumulates in the well *H* and can overflow into the well *K*. Juices accumulating in the well *K* can overflow directly into the continuous liming tank *M*. The diluted juices from the mills *C*, *D* and *E* are thus limed in the tank *M*, and are then pumped by the pump *P* through the juice heater *Q* and into the continuous settling tank *R*. The clarified juice from the continuous settling tank *R* is mixed with the juices from the crusher *A* and the first mill *B*, preferably after the latter juices have been limed in the tanks *G*. This may be done by means of the pump *T* which serves to pump the juices from the tanks *G* and *R* and to force the mixture of the juices through the heaters *U*, and



---

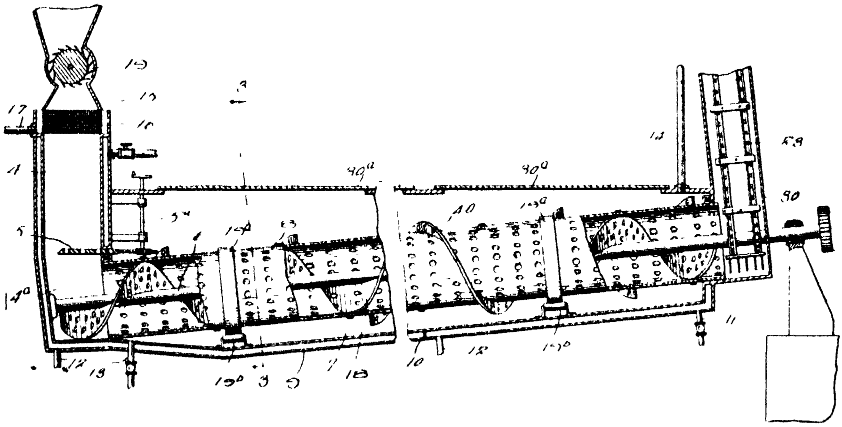
[1] Naudet's evaporator employing a "juice circulator" has been tested in Cuba, and it was stated that the fact of the juice in the body running from the upper tubular plate to the bottom through the tubes (thus, it is claimed, giving the benefit of film evaporation) alone means an increase of 10-15 per cent. in the evaporating power. See *I.S.J.*, 1915, 480

then to the usual clarifiers, etc., not shown. The settlings from the continuous settling tank *R* are passed into the scum tank *S*, and then pumped through the mud or filter-presses in the usual manner.

It will now be noted that the diluted juices from the mills *C*, *D*, and *E*, are segrated from the juices first expressed by the crusher *A*, and the first mill *B*, and that they are strained, limed, heated and settled, thus eliminating impurities before being added to and mixed with the strained and limed juices first expressed, the purity of the total mixed juice being raised thereby. This method permits of a better control of the dilution and of the maceration, the losses by inversion being reduced, the fouling of the evaporators, heaters, and pans diminished, and a higher efficiency obtained.

BEET DIFFUSION APPARATUS. *John Stewart,* of Logan, Utah, U.S.A. *1,189,502.* Patented, July 4th, 1916.

Instead of flowing the pulp through a stationary chamber, by means of a screw conveyor therein, as in a previous specification,[1] it is passed through a rotary barrel or cylinder containing a spiral conveyor, which cylinder rotates in a trough through which the water is flowed, the effect being to tumble or roll the material over and over as it passes through, so that in consequence of the agitation of the material in the liquid a better and more complete extraction is obtained. The cylinder is made of perforated metal, as well as the screw therein, so as to permit or produce an intimate mixture or association of the water and pulp as they flow therethrough. This trough is heated by means of a steam jacket, to different degrees at different points, similarly to the prior apparatus Moreover, the present construction is such that shorter vertical and inclined legs may be employed, and a denser solution obtained.



Referring specifically to the drawings, *4* indicates a vertical leg into the top of which the pulp or material is introduced from any suitable shredding or disintegrating machine indicated at *19*. This leg is provided at the top with a strainer of reticulated metal *15*, opening into a surrounding chamber *16* having an outlet *17* for the juice. Within its lower end, the leg *4* is provided with a gate valve *5* of perforated metal to permit the rise of juice, which controls the flow of pulp from the leg to the rotary cylinder The valve may be operated by any suitable device as indicated at *5*^{a}. Below the valve, the leg has a lateral circular opening or bearing for the end of an elongated perforated cylinder *8* in which is a central shaft *6* and a screw conveyor *18* of perforated metal, the edges of the screw being fixed to the shaft and the cylinder, so that all rotate together. The lower end of the screw projects beyond the end of the cylinder, into a semi-circular chamber *4*^{a} at the foot of the leg *4*, the extension of the screw thus acting to convey the pulp from the leg into the cylinder *8*, and the screw carrying the pulp upwardly or outwardly through the cylinder to the point of discharge, where it is conveniently delivered into a casing *30* in which may be provided a belt conveyor *23* for lifting and discharging the spent material. The shaft and its connected parts are rotated by power applied to the outer extended end.

---

[1] U.S. Patent, 962,725.

The cylinder is mounted in an inclined trough *7*, upon rollers 19^b journalled in this trough, the cylinder having rims resting upon the rollers, and through the trough water is flowed from an inlet *14*, rising in the vertical leg *4* to the outlet strainer *15* and pipe *17*. The water supplied by the pipe *14* will be cold, or of relatively low temperature, and in addition to this water inlet, graduated hot water inlets *13* one of which opens through the bottom of the trough near the lower end of the vertical leg, and others at different points along the trough are provided. It will be seen that the direction of the flow of pulp is opposite to that of the water in both the inclined and the vertical legs, and that the perforations in the cylinder *8* and the flights *18* permit the circulation of the water through the pulp in the cylinder, the rotation of the latter causing agitation which is conducive to the complete extraction of the sugar. The trough is surrounded by a steam jacket *9*, which is divided by partitions *10* into several sections, each having a steam inlet *11* and an outlet *12* for condensed water. The vertical leg is similarly jacketed, and the sections are heated to different temperatures, the highest being around the vertical leg, and the lowest at the discharging end. The inclination of the trough and the height of the casing *30* is such that the point of pulp discharge is higher than the outlet *17*, so that the discharge of the juice is effected by overflow through the outlet.

In operating the apparatus, the disintegrated pulp falls through the vertical leg *4* into the trough. whence it is conveyed by the screw through the rotatory cylinder to the point of discharge, flowing upwardly through the cylinder, and the gate *5* is preferably so adjusted that the cylinder will be only partly filled with the material, which will be in the state of suspension in the water in the trough. The flow of water through the trough is in the contrary direction, down the inclined leg and up the vertical one to the outlet, thereby circulating through the pulp and extracting therefrom the sugar. In order to prevent too rapid a flow of water, the exterior of the cylinder *8* may be provided with a screw blade *40*, thus furnishing an obstruction to the flow of the liquid outside the perforated cylinder and tending to force it into the interior thereof, and at the same time conveying small solid particles which may pass through the perforations of the cylinder to the outlet end for the pulp. The stirring device in the vertical leg, described in the former patent referred to,[1] may also be used in the present apparatus, if desired.

UNITED KINGDOM.

MANUFACTURE OF ALCOHOL FROM THE JUICE OF THE AGAVE PLANT AFTER A PRELIMINARY CLARIFICATION. *Lucien Lavedan*, of 2522 Berlin Street, New Orleans, U.S.A. *101,261*. (Application No., *5762* of 1916.) April 19th, 1916.

Efforts to produce alcohol from the juice of the Agave plant (*Agave sisalensis* or *Agave americana*) have not been successful, owing partly to the initial high organic acidity, which favours butyric and acetic fermentations, and partly to the high content of gummy, resinous and albumenoid matters, which retard the active propagation of the yeast, besides making subsequent rectification difficult.

Hence a special preliminary purification is adopted. The excess of acidity is eliminated by the addition of sodium carbonate (not of lime), leaving only a slight alkalinity, after which the juice is heated, and treated with sulphur dioxide at boiling point, this operation being conducted in open vessels. Lime sufficient to cause a slight alkalinity is now added, following which liquid is allowed to subside, and the free portion passed through filter-presses, the bright juice obtained being cooled and set with the proper amount of pure, selected, and acclimatized yeast to effect a normal alcoholic fermentation.

---

[1] U.S. Patent, 962,725.

MANUFACTURE OF FERTILIZER FROM MOLASSES AND VINASSE. *William P. Thompson*, of 6, Lord Street, Liverpool. (Communicated by *Abram I. Kaplan*, of New York, U.S.A.) *9270* June 24th, 1915.

Beet and cane molasses and vinasse (the residue left after the distillation of alcohol from fermentated wash) contain potassium and nitrogenous compounds, which may be utilized for the production of a complete fertilizer. This is done according to this invention by concentrating the spent liquor to about 44° Bé., treating the syrup with 30 to 50 per cent. of its weight of mineral phosphates, guano, or bone meal, and the resulting mixture with sulphuric acid. After a thorough incorporation the mass is cooled, and after standing for some time a dry fertilizer which can be spread very readily is produced. It is rich in organic matter, and contains phosphoric acid soluble in water, as well as potassium and nitrogen compounds.

It is necessary that the phosphates should be added in a finely-ground state. The amount of sulphuric acid required is determined by the quantity which is necessary to decompose the added phosphates in order to yield soluble phosphate, and also by the quantity necessary for the conversion of potassium carbonate of the concentrated molasses refuse into potassium sulphate. This amount, naturally, will vary with the nature of the refuse and is calculated in accordance with its composition and with that of the phosphatic material used.

UNITED KINGDOM APPLICATIONS.

CENTRIFUGAL SEPARATORS *W J. Gee. 7727.* May 31st, 1916.

PRODUCTION OF OXALIC ACID FROM SUGAR AND OTHER CARBOHYDRATES. *E. R. Portheim. 7863.* June 3rd, 1916.

FILTRATION OF SUGAR SOLUTIONS. *Butters & Co. and F. L. Bosqui 8117.* June 8th, 1916.

BOILERS *Circulators, Ltd. 8012.* June 6th, 1916.

OBTAINING OR IMPROVING MUSTS, WINES, HONEYS, SYRUPS, ETC. *E. Disdier. 8202.* June 9th, 1916.

FERTILIZERS *The Molassine Co., Ltd., and J. J. A. and H. C. S. de Whalley. 7954.* June 5th, 1916.

UTILIZATION OF WASTE HEAT FOR GENERATING STEAM. *W. H. Panton. 8364.* June 13th, 1916.

WATER-TUBE BOILERS. *J. P. Davies. 8802.* June 22nd, 1916.

TREATMENT OF PEAT FOR MANURIAL PURPOSES, AND FOR THE MANUFACTURE OF NUCLEIC ACID *W. B. Bottomley. 8914.* June 24th, 1916.

MARMALADE MANUFACTURE. *R. J. Russell. 8951.* June 26th, 1916.

EVAPORATOR *G. A. Krause. 9046, 9047.* June 27th, 1916.

FERMENTATION PROCESS. *G. A. Hamlyn and C. Weizmann 9181.* June 29th, 1916.

CONSUMING SMOKE AND INCREASING EFFICIENCY IN FURNACES OF CORNISH OR LANCASHIRE BOILERS *G. Watson. 9213.* June 30th, 1916.

CHOCOLATE AND FONDANT COVERING MACHINE. *F. J. Michallat. 9284.* July 3rd, 1916

DECORATING CONFECTIONERY. *G. White. 9542.* July 6th, 1916.

JUICE EXTRACTING MACHINE. *J. W. Hyatt. 9558.* July 6th, 1916.

EVAPORATOR. *G. Fletcher & Co., Ltd., and F. Coxon. 9632.* July 8th, 1916.

FILTERING APPARATUS *Vickers, Ltd., J. P. Clear, and J. McKechnie. 9665* July 8th, 1916.

RE-BURNING USED FINELY-POWDERED DECOLORIZING CARBONS. *A. Wijnberg. 10,092.* July 18th, 1916.

Sugar Crops of the World.

(Willett & Gray's Estimates of Cane Crops, January 25th, 1917)

	Harvesting Period.	1916-17. Tons.	1915-16. Tons.	1914-15. Tons.
United States—Louisiana	Oct.-Jan.	273,000	122,768	216,696
Texas	,, ,,	6,250	1,000	3,500
Porto Rico	Jan.-June	450,000	431,335	308,178
Hawaiian Islands	Nov.-July	575,000	529,895	577,186
West Indies—St. Croix	Jan.-June	12,000	14,750	4,500
Cuba, *crop*	Dec.-June	3,400,000	3,007,915	2,592,667
British West Indies—Trinidad	Jan -June	65,000	64,231	58,822
Barbados, *exports*	,, ,,	65,000	65,000	32,578
Jamaica ,,	,, ,,	15,000	15,143	15,063
Other British West Indies	,, ,,	30,000	30,000	24,000
French West Indies—Martinique, *exports*	Jan.-July	40,000	38,925	38,581
Guadeloupe	,, ,,	40,000	40,000	40,000
San Domingo, *exports*	Jan.-June	150,000	126,058	108,267
Mexico, *crop*	Dec -June	50,000	65,000	110,000
Central America	Jan.-June	35,000	35,000	36,275
South America—				
Demerara, *exports*	Oct.-Dec. and May-June	120,000	116,224	113,632
Surinam, *crop*	Oct. Jan.	15,000	13,000	12,000
Venezuela	Oct.-Dec.	15,000	7,000	3,000
Peru	Oct -Feb.	250,000	250,000	262,841
Argentine	June-Oct.	175,000	152,301	335,833
Brazil, ,,	Oct.-Feb	225,000	194,000	240,000
Total in America		6,006,250	5,319,545	5,133,619
Asia—Brit. India, *crop* (consumed locally)	Dec.-May	2,400,000	2,636,875	2,460,573
Java, *exports*	May-Nov.	1,595,260	1,198,567	1,303,045
Formosa and Japan, *crops*	Nov.-June	430,000	391,549	262,000
Philippine Islands, *exports*	,, ,,	170,000	316,450	243,000
Total in Asia		4,595,260	4,543,441	4,268,618
Australia	June-Nov.	175,000	150,000	246,408
Fiji Islands, *exports*	,, ,,	100,000	90,000	102,000
Total in Australia and Polynesia		275,000	240,000	348,408
Africa—Egypt, *crop* (consumed locally)	Jan.-June	100,000	100,000	75,738
Mauritius, *crop*	Aug.-Jan.	220,000	215,528	277,164
Réunion, *exports*	,, ,,	45,000	45,000	39,267
Natal, *crop*	May-Oct.	125,000	112,000	91,619
Mozambique, *crop*	,, ,,	55,000	50,000	40,000
Total in Africa		545,000	522,528	523,788
Europe—Spain	Dec.-June	6,000	6,359	7,376
Total cane sugar crops		11,427,510	10,631,873	10,281,809
Europe—				
Beet sugar crops	Sept.-Jan.	5,004,000	5,077,760	7,583,215
United States—				
Beet sugar crops	July-Jan.	775,000	779,756	646,257
Canada—				
Beet sugar crop	Oct.-Dec.	14,000	17,641	13,979
Grand total cane and beet sugar	Tons	**17,220,510**	**16,507,030**	**18,525,260**
Estimated increase in the world's production	,,	713,480		

United Kingdom.

IMPORTS AND EXPORTS OF SUGAR.

IMPORTS.

	One Month ending January 31st.			
Unrefined Sugars.	1916. Tons.*	1917. Tons.*	1916. £	1917 £
Russia	....	....	....	
Germany	....	....	....	....
Netherlands	....	....	....	....
Belgium	. .	....	...	....
France	....	....	....	....
Austria-Hungary	....	....	....	....
Java	9	86,570	160	2,131,551
Philippine Islands	7,570	15	108,506	295
Cuba	7,961	...	145,236	....
Dutch Guiana	853	317	19,973	8,867
Hayti and San Domingo	....	....	....	....
Mexico	....	....	....	....
Peru	7,767	5,526	136,385	120,540
Brazil	1	4,157	15	86,885
Mauritius	19,967	....	363,054	....
British India	....	....	....	....
Straits Settlements	....	....	....	....
British West Indies, British Guiana & British Honduras	2,127	2,660	44,666	72,384
Other Countries	761	....	14,631	....
Total Raw Sugars	**47,016**	**99,245**	**832,626**	**2,420,522**
Refined Sugars.				
Russia	....	....	....	....
Germany	....	....	....	....
Holland	4,189	....	107,513	....
Belgium	....	....	....	....
France	....	....	6	....
Austria-Hungary	. ..	....	....	....
Java	18	19,560	389	627,438
United States of America	35,731	26	840,726	835
Argentina	251	....	6,526	....
Mauritius	13	....	252	5
Other Countries	3	32	141	1,068
Total Refined Sugars	**40,205**	**19,618**	**955,553**	**629,346**
Molasses	8,874	8,928	48,619	107,677
Total Imports	**96,095**	**127,791**	**1,836,798**	**3,157,545**

EXPORTS.

British Refined Sugars.	Tons.	Tons.	£	£
Denmark	....	....	....	3
Netherlands	..	....	...	....
Portugal, Azores, and Madeira	.	....	4	3
Italy	. ..	....	....	....
Canada	....	....	....	12
Other Countries	1,349	145	36,764	5,568
	1,349	145	36,768	5,586
Foreign & Colonial Sugars.				
Refined and Candy	126	1	3,015	15
Unrefined	7	73	197	2,032
Various Mixed in Bond	....	...	....	....
Molasses	267	....	2,500	15
Total Exports	**1,749**	**219**	**42,480**	**7,648**

* Calculated to the nearest ton.

United States.

(Willett & Gray, &c.)

(Tons of 2,240 lbs.)	1917 Tons.	1916 Tons.
Total Receipts January 1st to January 25th	122,716	123,965
Receipts of Refined ,, ,,	—	—
Deliveries ,, ,,	133,681	125,068
Importers' Stocks, January 24th	—	2,975
Total Stocks, January 24th	75,026	58,224
Stocks in Cuba, January 24th	111,443	146,288
	1916.	1915.
Total Consumption for twelve months	3,658,607	3,801,531

Cuba.

STATEMENT OF TOTAL EXPORTS AND STOCKS OF SUGAR, 1913-1914, 1914-1915, AND 1915-1916.

(Tons of 2,240 lbs.)	1913-14. Tons.	1914-15 Tons.	1915 16. Tons.
Exports	22,936	42,034	2,823
Stocks	30,990	41,995	45,939
	53,926	84,029	48,762
Local Consumption	750	820	1,730
			50,492
Stocks on 31st December (old crop)	— —	——	13,798
Receipts at Ports, December 31st	54,676	84,849	36,694

Havana, December 31st, 1916 J. GUMA.— L. MEJER.

United Kingdom.

STATEMENT OF IMPORTS, EXPORTS, AND CONSUMPTION OF SUGAR FOR ONE MONTH ENDING JANUARY 31ST, 1915, 1916, 1917.

	IMPORTS.			EXPORTS (Foreign).		
	1915. Tons.	1916. Tons	1917. Tons.	1915. Tons.	1916. Tons.	1917 Tons.
Refined	59,411	40,205	90,618	47	126	1
Raw	114,556	47,016	99,245	44	7	73
Molasses	8,622	8,874	8,928	5	267	—
	182,589	96,095	127,791	96	400	74

	HOME CONSUMPTION.		
	1915. Tons.	1916. Tons.	1917. Tons.
Refined	39,876	45,039	17,261
Refined (in Bond) in the United Kingdom	67,466	56,466	47,097
Raw	24,622	10,070	27,852
Molasses	12,718	6,958	8,996
Molasses, manufactured (in Bond) in United Kingdom	4,910	5,550	4,938
Total	149,592	124,083	106,144
***Less* Exports of British Refined**	354	1,349	145
	149,238	122,734	105,999

THE

INTERNATIONAL SUGAR JOURNAL.

No. 219. MARCH, 1917. Vol. XIX.

☞ All communications to be addressed to "The International Sugar Journal," 2, St. Dunstan's Hill, London, E.C.

Cheques and Postal Orders to be made payable to "The INTERNATIONAL SUGAR JOURNAL," and not to individuals

☞ The Editors are not responsible for statements or opinions contained in articles which are signed, or the source of which is named.

The Editors will be glad to consider any MSS. sent to them for insertion in this Journal and will endeavour to return the same if unsuitable; but they cannot undertake to be responsible for them unless a stamped addressed envelope is enclosed.

Notes and Comments.

Food Rationing.

We were perhaps unduly pessimistic in expressing our view last month that the system of voluntary rationing introduced by Lord Devonport was hardly likely to be a success. At any rate the Government profess by now to be more satisfied with the result than they could conceivably have been a year or two ago. A very considerable proportion of the nation have patriotically responded to the appeal to their honour, though the south seems to have made a better showing than the industrial north where money is plentiful and the situation is probably less adequately realized. It is difficult to sum up the situation accurately when any week brings fresh kaleidescopic changes; but it would appear to be the case that while Lord Devonport at the outset of taking office as Food Controller expressed himself decidedly in favour of rationing, at all events as regards sugar, a more prolonged study of the problem has probably shown him that any system of rationing involves so much extra official work and supervision that it should only be resorted to as a last expedient. For the moment then, to judge from the various statements made in Parliament, the voluntary system is to be given a further trial, and doubtless the Government hopes that it will suffice to save the situation. But there is no doubt that preparations are being carried through to organize compulsory rationing and it is impossible to say when and to what extent it will be enforced if at all. Much depends of course on the extent to which the submarine menace is overcome, on the availability of shipping, especially neutral shipping which appears to be the chief sufferer from the unrestricted German submarine campaign, because it is blockaded in its home ports, and on the success of the present year's production of food in this country—a bad growing season would naturally have its effect on the amount of home-grown food available. But it is clear that the Government will leave no stone unturned to retrieve the stringent situation; the latter is largely a legacy of their predecessors in office, who utterly misjudged the ultimate outcome of the U-boat campaign and failed to take steps in 1915 to augment the home production of food; as a consequence it is only in 1917, or nearly two years later, that our agriculture is being given a chance of producing a war output. We can only hope that the efforts now being put forth will meet with adequate success.

Imperial Preference.

A big step towards the inauguration of British Imperial Preference has been accomplished lately by the decisions come to by the Parliamentary Committee on our Commercial and Industrial Policy after the war, which has formulated an important set of resolutions and forwarded these to the Prime Minister as a basis on which it is hoped the Government will eventually take action. Elsewhere we reproduce these resolutions, as well as the covering letter addressed to Mr. LLOYD GEORGE.

This Committee is composed of men drawn from both schools of economic thought, that is, from both free traders and tariff reformers. Its chairman is LORD BALFOUR OF BURLEIGH, one of the old Conservative free traders who refused some years ago to follow the trend of his party towards tariff reform. The Committee was in fact appointed by the late Asquithian Government and could not by any stretch of imagination be said to be weighted in favour of tariff reform. But the war has been a great eye-opener and by revealing the insidious ramifications of German trade all over the world has emphasized the fact that one-sided free trade is not in the aggregate a paying proposition, and that a certain amount of restraint in trade is a small price to pay for safeguarding the resources and interests of the British Empire from unscrupulous attacks by a foreign trade which is subsidized or otherwise secretly aided by its own Government. Hence every member of the Committee, even those to whom anything not free trade is in the abstract distasteful, think that for the sake of the unity of the Empire and having regard to the declared wishes of the Dominions and Colonies for the development of their economic relations with the United Kingdom, it is expedient that the Government should now declare their adherence to the principle that preference should be accorded to the products and manufactures of the British Overseas Dominions in respect of any Customs duties now or hereafter to be imposed on imports into the United Kingdom.

As the *Times* well puts it, "there is no need to emphasize the greatness of the change in the attitude of our public men which the unanimous adoption of such resolutions reveals; it shows how penetrating and how purifying to all patriot minds have been the stern lessons of the war." All that men with an imperial outlook have asked for the last 15 to 20 years is now ungrudgingly conceded in the interests of the unity of the Empire, an Empire which it must never be forgotten has sent willingly and abundantly of its sons to fight the common battle for freedom and humanity in Europe. No longer, we assume, will the cult of the Little Englander rule our destinies and endanger our future existence. The lessons we have learnt and are still learning are too heavy not to impress themselves firmly on all reasonable minds, and the present discomforts, comparatively mild as they still are, of a restricted food supply will convey to the humblest home in the land the desirability of a greater measure of self-help—greater production within our own borders, and what we cannot so produce to be procured preferably from within our own Empire. This surely is one of the biggest victories so far of the war.

Its Bearing on Sugar.

The resolutions of the Committee naturally relate only to principles and do not concern themselves with details, save that they indicate that the proposed preference is to operate through present or prospective Customs duties. As sugar has been for a considerable time a valuable medium for obtaining revenue through such duties, and all the machinery for collecting it is in existence, it seems a foregone conclusion that this commodity will be one of those which will be included in any scheme of preferential tariffs. Granting this assumption to be reasonable, it follows that the door is now opening for the encouragement and extension of the sugar industry within the British Dominions and Colonies, and that there is at last a prospect that capital will be attracted to British sugar ventures, sure in the knowledge that any sugar produced under such auspices will no longer have to compete at a disadvantage with subsidized Continental beet or favoured neutral cane sugar. British sugar planters can now surely take heart, and feel that the days of neglect are within measurable distance of being terminated, and that once the war is brought to a satisfactory ending, their claims will receive really reasonable consideration.

The resolutions of the above Committee are not of course binding on the Government or on Parliament, but they represent so fully the opinions now held by the vast majority of the nation, that there is little fear lest the Government should decline to adopt them when the right moment comes. We are on the eve of a fresh Imperial Conference which, while called together primarily to discuss the most expedient conduct of the war, will almost certainly go on to formulate after-war plans, and the lead which the Committee has now given the Government will doubtless enable the latter to discuss with a freer mind ways and means to accomplish the common object in view. When the Conference has done its work we may learn some details of the proposed *modus operandi.*

Home Sugar Beet.

There seems at length to be evidence of more willingness on the part of the Government to further the advancement of home beet sugar production; but unfortunately this branch of our agriculture appears to be still sidetracked, ostensibly because the Government have not yet provided themselves with sufficient data to show whether the industry will prove a commercial success. At any rate questions in Parliament last month elicited the statement that the Government were still uncertain whether sugar beet could be commercially *manufactured* into sugar at a profit in normal times in this country. "Until that is settled, it is of no use to divert land from the cultivation of essential crops or to allow the establishment of factories for the making of beet sugar." And since then Mr. PROTHERO, the President of the Board of Agriculture, has reiterated that "it has not been proved that sugar can be manufactured at a profit from home-grown beet after paying an adequate price to the grower."

We must say it is surprising to find the Government through the Board of Agriculture pleading that they were still unaware whether we could *manufacture* sugar in this country at a commercial profit. They have to all appearance now satisfied themselves that we can grow the roots, and the plea that we cannot do so is no longer advanced; but one would have thought that if they did trouble to satisfy themselves on this point through a series of investigations extending over several years, they would simultaneously have considered the feasibility of the manufacturing side too as a commercial proposition, as without this side there is no object in growing the beets. But apparently this aspect of the problem has never been tackled, if we are to judge from the above Parliamentary replies, and so we are at the moment no nearer the definite official recognition of this most important new industry.

If the Government really do not know whether or not sugar can be profitably manufactured from sugar beets grown in this country, then the sooner they take thorough steps to find out the better. They might do worse than appoint a Committee of experts to go into the question and if possible pay a visit to some beet sugar producing centre either on the Continent or in the United States. Although we cannot make a start with the erection of sugar factories in England before the war is over, is there any reason why the war should come to an end before anything is done to go into the question of whether sugar factories are paying propositions or not?

It is possible, though, that the Government have some intentions this way; at any rate Mr. PROTHERO's latest statement shows that his department now realizes that the establishment of such an industry in this country would promote agricultural progress, create a valuable rural industry, and increase employment after the war; and accordingly it is endeavouring to secure the means of making the experiment. But unfortunately the war conditions preclude the provision of the necessary buildings and machinery. This latter drawback is undoubtedly a sufficiently weighty one, but it only concerns the present situation. The Government should take early steps to devise plans which would ensure the development in earnest of an industry, which on their own admission would promote agricultural progress in this country, and then when the war is over there would be no time wasted in putting them into execution.

But we are not so sure that the crux of the problem is the manufacturing side. There is really no more reason why we should not be able to make raw sugar at a profit in this country than to refine it. It is merely a matter of organization and the adoption of the most modern methods of operation. No conclusive evidence can be adduced from the experience of Cantley, as no one supposes that this factory was ever more than a makeshift one, and it has never been free from difficulties, most of them due to inadequate supplies of raw material. It is the latter supply, the production of sugar beets, which appears to us to govern the situation. Grant that at the present moment every available acre of land in this country is needed for the production of the more familiar staple crops of food, and that therefore it is inexpedient to encourage any extended sowings of sugar beets as long as the present food stringency continues. But it is possible that the present revival in our British agriculture, backed as it is to be by minimum prices for a number of years ahead for cereals, may after the war make the farming community within the United Kingdom more disposed than ever to stick to their familiar crops and less inclined to experiment with a comparatively unknown one.

This is a possibility that has to be faced, and it will rest with the Government to decide whether the value of sugar beets to agriculture in general is great enough in their opinion to warrant them offering the agricultural community sufficient inducement to get them to take up the new culture on a wide scale. The increased home production of corn is a great desideratum, but if we are to be independent to a greater extent than hitherto of imports of overseas corn, we need equally to be to some extent independent of overseas sugar. A firm policy is therefore called for, and it should not be left to our farmers to decide solely for themselves whether they will add the newcomer to their staple crops or not. They must be taught the advantages that accrue from growing sugar beets in rotation, and the lesson should be made sufficiently attractive to give them no excuse for dropping the experiment subsequently.

Notes and Comments.

The Registration of Business Names Act.

One of the chief pieces of legislation that have been enacted since the war broke out, with a view to counteracting enemy influence in our commerce, is the Registration of Business Names Act which has for its object the prevention of any individual or private firm from trading in any other than the real name without revealing the fact and publishing on the business documents the real nomenclature. Thereby it will be impossible for foreigners to resort to the practice, so common in the past, of starting business in this country under an assumed name which leads customers to think that it is a purely English firm, while actually the names of the owners may end in "stein" or "baum." Necessarily, all firms trading in this country have been affected by this Act save limited liability companies (and these, too, are now to be covered by an amending Act, as it has become apparent that large numbers of firms of questionable nationality, who were about to be identified, were seeking to escape exposure by turning their businesses into limited liability companies); under its provisions individuals who are not British will have to state their nationality or their nationality of origin if they have changed it at any time, while British firms or individuals will have to give the real names of the partners or owners.

The Act has been somewhat hurriedly drawn up and there are a number of contentious points about its interpretation which may give rise to a crop of legal actions. The following points may be of some interest to our British readers though they are only given here as opinions and not as legal facts. The question as to what documents are included amongst the documents specified in Section 18 as being the ones which must bear the identifying nomenclature is a legal one which is not fully established in the Act. Thus postcards would appear to be open to argument. On the other hand, it is assumed that invoices are not liable nor are receipts, for the reason that both come at a stage in the transaction when it may be assumed that the identity of the firm is no longer in question. In fact it is probable that the classification of the doubtful items of stationery will rest on whether these are used to open up a transaction or are merely to convey some information after the transaction has been agreed to. An offer to sell or an inquiry for a quotation which is written on a postcard would, in that event, be liable to reveal simultaneously the identity of the parties sending the card in question. But a postcard communication sent in the course of executing a transaction might well claim the same exemption as invoices do. There is, however, no legal rule as yet, and unfortunately the Registrar's department does not undertake to settle such legal points.

The Act appears to show that it applies to all persons having a place of business within the United Kingdom, and not otherwise; but it also appears to be the case that a business in this country which is merely the agency of a foreign firm and has no power to do business without reference to its foreign principal is at present exempt from the need to register.

Another point is that the business documents which have to bear the identifying names, if any, are only required in respect of communications issued or sent to any person in any part of His Majesty's dominions. Hence those sent to foreign firms would appear to be exempt if it is so desired.

Finally there is the question as to whether advertisements of British firms in British papers come within the classification of documents that have to bear the identification statement. This is not one of the points that is clear, but an advertisement is for all practical purposes equivalent to a trade circular or a show card, hence the strict interpretation of the wording of the Act would suggest that it was liable.

The hurried introduction of this legislation has in fact given rise already to so many doubtful points that it will probably be necessary to pass amendments through Parliament to rectify the inequalities and clear up the uncertainties.

Electric Power in Sugar Factories.

With the extension of the use of electricity for motive power in sugar factories, the desire is doubtless felt by owners, managers, and others concerned to learn more about electrical supply, its pros and cons, and its varied forms and uses, in order to be in a position to choose the most suitable installation when it comes to making changes in, enlarging, or even rebuilding the factories.

In the latest designs of beet sugar factories, electricity has found extensive application for the driving of numerous motors; inside, for driving pumps, endless carriers, centrifugals, fans, etc.; outside, for cranes which serve to unload the raw material. A short while ago the Dutch Technical Society of Sugar Manufacturers and Refiners realized the desirability of getting more information on the subject, and accordingly they invited a Dutch electrical engineer, Mr. H. W. VAN DER LEE, to give a lecture to the members, and demonstrate the fundamental truths regarding electrical currents in general, the peculiar difference between alternating and direct currents, and finally to show which of these is particularly adaptable when it comes to chosing motive power for sugar factories.

Mr. VAN DER LEE's lecture has been printed in the Journal of the above-mentioned society; and as we think it might be of advantage to our readers to study it, we are giving in the next few numbers a somewhat abridged translation of the paper in question, for permission to reproduce which we have to thank the Secretary of the Society, Mr. C. L. BRUNINGS. The first part of the paper is purely technical, and presupposes an acquaintance with electrical theory, but we think it best to give the paper approximately as the author delivered it, and not confine it to the part dealing with the application to the sugar factory. Though prepared in the first instance for beet sugar fabricants, it is doubtless fairly applicable to the practice involved in cane sugar factories, save perhaps as regards the power for the cane mills, which has no exact counterpart in the beet sugar usine.

Dividends.

The following are some of the principal dividends that have been declared by sugar concerns the last few months. The Cuban-American Sugar Company had what must be considered a record year in 1916, as the dividend on the common stock in cash and scrip was equal to 60 per cent. The net profit amounted to $8,235,112, as compared with $5,594,000 the previous year.—The third annual report of the St. Madeleine Sugar Co., Ltd., Trinidad, reveals a largely increased output, amounting to some 33 per cent., but owing to the fact that this company, registered in England, had no pre-war record, the assessment for income tax was so heavy that £114,339 had to be carried forward to meet their liabilities in this respect. As a consequence, a dividend of no more than 6 per cent. plus 2s. per share was available. The Company now get an average of 2⅝ tons of sugar per acre.—Sir J. L. Hulett & Sons, Ltd., of Natal, had a sugar output for the year ending last June of 41,413 tons, which constituted a record, and the sales produced £206,220 more than in the previous year. The net profit is given as £67,988 after putting £32,500 to reserve, setting aside £15,000 for income tax, writing down investments by £5,000, and applying £45,297 to depreciation account. The dividend announced was 10½ per cent., which compared with 8 per cent. the previous year, and 12 per cent. in 1911-12.—The Credit Foncier of Mauritius, Ltd., had a smaller crop last year owing to drought. The net profit was £37,652, which with the amount carried forward the previous year made the total available £47,475. After providing for depreciation, they proposed a dividend of 5 per cent., and carried forward £27,388, out of which sum, however, they have to meet Treasury claims for two years' excess profits.—The East India Distilleries and Sugar Factories, Ltd., made a profit for the year ending September 30th last of £39,400. A dividend of 10 per cent. was paid, while £17,000 was placed to reserve, and £3013 carried forward.—The Acadia Sugar Refining Company of Nova Scotia showed in its recent report a net trading loss of £40,919, to which falls to be added £28,883 interest on loans, and £1500 directors' fees. Deducting the credit balance £22,071 brought forward, the debit balance of the profit and loss account stands at £49,231. No allowance was made for depreciation.

The High Price of Sugar.

In 1914, before the war, there was every appearance of an abundant supply of sugar at a very moderate price. The excitement of the British Government when war broke out sent prices up to a very fancy figure, at which they succeeded in securing a million tons to go on with. Then prices went down again, so they prohibited importation and the consumer paid the piper. Violent fluctuations have taken place since then, followed by a scarcity of ships, which justified the Government in taking complete control of the supplies and the prices.

There does not appear to be any fear of high prices after the war. On the contrary, present high prices are stimulating an increased production of cane sugar throughout the world, and of beetroot sugar in the United States. We need not, therefore, search for means of increasing supplies in far-fetched ways. The only search of that kind is for sufficient production in the British Empire to make us, eventually, more or less independent in future of outside supplies.

There have been some curious imaginings as to whence the British supplies should come. The idea of getting a large increase from British Guiana by tapping the Hinterland of that large but almost unknown country is, at present, pure imagination. No one knows anything as yet of the capabilities of that remote land, but we do know that sufficient labour is not there, nor roads, much less railways.

Then some are speculating, like Mr. HAROLD HAMEL SMITH in a book just published,[1] on our being able, in some happy future, to rival Java and Hawaii in their phenomenal crops, producing an average of more than four tons of sugar to the acre. It is to be feared that we shall not, at present, succeed in finding many spots in the world of Imperial Britain where such crops will rapidly appear.

Java is blessed in more ways than one with exceptional advantages. First, there is a good supply of labour. Then there are excellent facilities for a large system of irrigation, which brings not only water but also a most fertilizing slime on to the land. Thirdly, the sugar is a rotation not a solitary crop. The canes are, therefore, all plant canes, never ratoons. The crops which intervene help to add to the fertility of the soil. To these natural advantages we must add great capability on the part of the Dutch planters which has brought the Java industry to an exceptionally high pitch of perfection. This has combined with nature to bring the cost of production down to a very low figure.

---

[1] "The High Price of Sugar and how to reduce it, by increasing the output within the Empire." By H. HAMEL SMITH, editor of *Tropical Life*. Paper covers, demy 8vo., 1s. 3d. post free. (London: Bale, Sons & Danielsson.)

Hawaii has similar advantages as regards irrigation, which has been developed on a most generous scale, thanks to the large preferential treatment of sugar from the Sandwich Islands in the markets of the United States. No such violent stimulus has yet been applied to British sugar industries, but perhaps it may come and then we may go ahead, not only, it is to be hoped, with energy but also perhaps with sufficient intelligence and capacity to enable us to compete to some extent even with Java in the tropics and Germany in the beetroot industry.

But in any case let us avoid dreams and turn our minds to getting things done.

G. M.

Notes on American Sugar Production.

(From our American Correspondent.)

Probably never before have so many unforeseen and unsettling influences arisen within a similar length of time to disturb the sugar market as it has experienced during the past few months. Drought, frost, and snow have in turn assailed the crops in different sections. Scarcity of labour, strikes, and now an insurrection in Cuba have interfered with the harvesting and milling of the cane. Lack of ocean tonnage and congestion on the railways have restricted the movement of both raws and refined. Other untoward conditions have played a part in the situation with the result that the outlook is radically different and decidedly less encouraging than was the case last autumn or even at the opening of the present year.

All the earlier estimates of production pointed to a record-breaking output of sugar in the United States and Cuba during the present season. It was predicted that the Cuban crop would exceed 3,500,000 tons, an increase of more than 500,000 tons above last season. The beet sugar industry was expected to show a gain of roundly 100,000 tons. A similar increase was anticipated in Louisiana, while Hawaii promised a gain of 40,000 tons and Porto Rico about 30,000.

Louisiana alone has realized these early expectations, although Hawaii may yet do so, as reports from Honolulu indicate that harvesting and grinding are proceeding under favourable conditions. For the other producing areas contributing to the American market, however, it has been necessary to scale down preliminary estimates of production sharply and repeatedly as the season has progressed.

The beet-slicing campaign is practically at its end. One factory is still in operation at the time of writing, but the season is virtually closed, and reports at hand indicate that the output of sugar from beetroot is approximately 35,000 tons *less* than during the season 1915-16. The early arrival of unseasonably severe cold in the Rocky Mountain section, freezing thousands of acres of beets while still in the ground, and a disappointing yield in the Central States, due to unfavourable weather during the growing and harvesting season, combined to bring about this decline in place of the anticipated increase.

This outcome was foreseen before the beginning of the present year, but it was still felt that the Cuban crop would be large enough to overcome any possible deficiency in other producing sections. With every passing week since the Cuban mills began operation, however, it has become more and more clear that Cuba would fall below the mark set for her by the crop experts until now everyone with a fair knowledge of the situation realizes that the Cuban crop will fall below last year's figure of 3,000,000 tons. The riddle which the market is now trying to guess—and nothing better than guesses can be advanced at present—is how far below last season's record the final figures will stand.

The Cuban campaign was late in getting under way. Much of the cane tasseled indicating a probable sugar content below earlier expectations. The shortage of labour became acute, and led the Cuban Government to suspend its restriction on the importation of labourers. The Cuban railways were crippled by strikes and by lack of cars, making transportation irregular and difficult.

During the past fortnight these difficulties have been multiplied, and new dangers have been added by the outbreak of an insurrection which began in the Eastern Provinces, and has affected to some extent practically every section of the island where sugar is grown. Just how serious the rebellion in Cuba will prove to be, and how greatly it will affect the sugar crop, it is impossible to determine at present. The burning of cane fields and of sugar mills has been a feature of revolutionary movements in Cuba in the past, and private advices received here are that the former of these two varieties of destruction has not been lacking in the present outbreak.

It has been generally assumed here that President Menocal will be successful in putting down the rebellion. This view has been strengthened by the statement issued to the Cuban people from Washington, warning them that the United States would not recognize a Government established by force, and carrying the clear implication that this country might feel compelled to intervene, under the terms of its treaty agreement with Cuba, should the situation seem to be beyond the control of the Cuban Government.

So far as the sugar industry is concerned it is recognized that, whatever the ultimate outcome may be, every week that present conditions continue in Cuba will mean a further reduction in the amount of cane that can be worked and the amount of sugar that can be produced. This condition has been sharply reflected in the advance that has taken place in this market in the quotations for both raws and refined, whereas a reduction in prices during this month had been generally anticipated by the trade.

The unrest and strife which afflict so much of the world is perhaps contagious. At any rate it has now spread to hitherto peaceful Porto Rico, and a general strike has been called there among the workers in the cane fields and mills. Reports from the island are that four centrals have been compelled to suspend operations thus far, and that others are running irregularly or with reduced forces. Higher wages, an eight-hour day, and yearly contracts are the demands of the striking workmen, and these the managers of the mills and plantations assert that they cannot possibly grant. Normally the Porto Rican campaign should just now be approaching its height, and a strike of prolonged duration can hardly fail to result in a serious curtailment of production.

Meanwhile, the refined market here is not without its troubles. Strikes have been in progress for some time in several of the big refineries in New York and Philadelphia. In addition to this limitation upon their operation the serious railway congestion which extends over the whole eastern half of the country makes it difficult and in some directions impossible to forward shipments to interior points. For the time being, the West is dependent upon the beet sugar factories, the Pacific coast refineries, and upon shipments from New Orleans. These have served to meet the situation thus far, but cannot be expected to do so indefinitely, particularly as stocks in distributors' hands are at unprecedentedly low levels.

As yet the export movement of refined sugar has been interfered with less than domestic distribution. The difficulty of securing ships in face of all the other insistent demands upon ocean tonnage is the chief handicap to exportation. Contracts in hand are moving fairly well, but refiners are treating inquiries for new export business with considerable reserve.

In view of existing conditions the market has behaved extremely well, and has shown less unsettlement than might have been expected. Its action has been far less erratic than that of other commodity markets, such as those for grain and cotton. Possibly this is because speculative operations in sugar are on a much smaller scale. The most noteworthy development is the revision of market opinion, which at the beginning of the year anticipated a somewhat lower level of prices for 1917 than prevailed during the past twelvemonth. In view of recent developments a continuation of earlier quotations, or possibly a movement to somewhat higher levels, is expected. Certainly there is little prospect of cheaper sugar in the near future.

New York, February 22nd.

Imperial Preference.

The following is a copy of three resolutions passed on February 2nd, 1917, by the Committee on Commercial and Industrial Policy on the subject of Imperial Preference, together with a copy of their covering Letter to the Prime Minister.

RESOLUTIONS.

1. In the light of experience gained during the war, we consider that special steps must be taken to stimulate the production of foodstuffs, raw materials and manufactured articles within the Empire wherever the expansion of production is possible and economically desirable for the safety and welfare of the Empire as a whole.

2. We therefore recommend that H.M. Government should now declare their adherence to the principle that preference should be accorded to the products and manufactures of the British Overseas Dominions in respect of any Customs Duties now or hereafter to be imposed on imports into the United Kingdom.

3. Further, it will in our opinion be necessary to take into early consideration, as one of the methods of achieving the above objects, the desirability of establishing a wider range of Customs Duties which would be remitted or reduced on the products and manufactures of the Empire, and which would form the basis of commercial treaties with Allied and Neutral powers.

The covering letter to the Right Hon. D. LLOYD GEORGE, M.P., Prime Minister, was as follows:—

Sir,—1. We think it expedient to state briefly the reasons which have led us to pass the accompanying Resolutions and transmit them to you at the present time.

2. It was our intention to discuss the future trade relations between the United Kingdom and the British Possessions Overseas in detail in connexion with and as part of the recommendations which it will be our duty to make in respect of the general commercial and industrial policy of this country after the war. In particular we desired to consider the position of the great staple industries, but in regard to these we feel bound to wait for the reports from the special Committees appointed by the Board of Trade.

3. The announcement that an Imperial Conference will be held at an early date has, in our judgment, made it expedient to state our opinions in the form of the Resolutions we have now the honour to transmit.

4. We have arrived at the conclusions indicated chiefly on the ground that although to some of us any measures which may act in restraint of trade are in the abstract distasteful, we think it necessary that for the sake of the unity of the Empire a serious attempt should now be made to meet the declared wishes of the Dominions and Colonies for the development of their economic relations with the United Kingdom, and that any abstract opinions we may hold should not, under the circumstances in which we are placed and with the experience gained during the war, stand in the way of any measures which are seen to be important, having regard to the general interests of the Empire.

5. It will be recalled that at the Colonial Conference of 1902 the Prime Ministers of the Self-Governing Colonies unanimously urged the expediency of granting in the United Kingdom preferential treatment to the products and manufactures of the Colonies either by exemption from or reduction of duties then existing or thereafter to be imposed, and that a Resolution in the same terms was passed at the Conference of 1907.

6. Whatever controversies may have arisen in the past, we think that, regard being had in particular to the sacrifices made and the services rendered by our fellow subjects overseas for a common purpose during the present war, the time has now arrived at which this request should be granted to the fullest extent which is now or may hereafter become practicable.

7. The Dominions have not asked, and we do not understand them to ask, that duties should be imposed by the United Kingdom for the sake of granting a preference to their products. But we feel that, in the words of the Resolutions we are forwarding to you, it will be necessary to take into early consideration, as one of the methods of achieving the objects indicated, the desirability of establishing a wider range of Customs duties than exists at present. This subject we propose to consider later, and to submit a further report thereon at an early opportunity, as well as on the question how far the interests of the Dominions could be met by the granting of subsidies in lieu of tariff preferences.

8. We do not overlook the practical difficulties involved, but we desire to emphasize the fact that for the purpose of recovering trade lost during the war, of securing new markets, and of consolidating the resources of the British Empire the development throughout the Empire of a system of mutual tariff preferences is a subject which cannot, in our opinion, any longer be neglected.

9. In this connexion it will be necessary to examine closely the effect of imposing duties upon any articles which are used for manufacturing purposes in this country, especially in connexion with our export trades and the shipping and shipbuilding industries. Measures must be devised to safeguard the interests of the consumer and the rightful demands of labour. The special position of India, as well as of Egypt and the Sudan, will require consideration ; and account must be taken both of our commercial treaty obligations and of the bearing of the proposed policy upon the interests of those countries, our trade relations with which are of special importance.

10. We are satisfied, however, that these questions, with which we propose to deal more fully in a subsequent report, do not oppose any insuperable obstacles to the adoption of the policy embodied in our Resolutions.

Indanthrene Blue, which was introduced by the Badische Anilin and Soda Fabrik some years ago as a substitute for ultramarine blue, is now being manufactured in England under the name of Chloranthrene Blue. It is the oldest anthracene vat dye, and very largely used in dyeing cotton and other fabrics.

The History of the Sugar Machinery Industry in Glasgow.

By ROBERT HARVEY, M.Inst.M.E
Chairman of the Harvey Engineering Co. Limited. Glasgow.

(Continued from page 61.)

In the year 1838 there was an engineering firm named STARK & FULTON in North Street, Anderston, Glasgow, who did general engineering work and also turned out one or two small locomotives. When the Helensburgh Railway was promoted they received an order for that line for four locomotives, but they had not had sufficient experience in the business, and their price was so far out that they failed before the work was finished, and the Railway Company had to supply the funds for its completion.

The foreman in these works, one PETER MCONIE, was a very clever and industrious engineer. When he saw that the works were to be closed, he looked about for another situation, but in those days few posts as foreman or manager were to be found. He therefore wrote to a friend who was engineer of a number of sugar estates in the Island of Trinidad, West Indies, enquiring if there was any chance of his obtaining a position as engineer out there. The reply was that there was no opening for an engineer at the moment, but that if he, PETER MCONIE, could start a small workshop in Glasgow, he might obtain some repair orders for sugar machinery from the Trinidad estates. PETER MCONIE considered the matter and thought it was a good opening, but he had no money to speak of. He therefore put the scheme before his brother, WILLIAM MCONIE, who carried on business in the Cowcaddens in Glasgow as a "victualler," that is a merchant who sells general grocery and also wines and spirits. Now William had saved over one thousand pounds from his business; and that sum, Peter assured him, was enough to set a small workshop going. Accordingly it was finally arranged that William should close his business in the Cowcaddens and join Peter in this new adventure. They secured a piece of ground on the south side of the river, at the corner of West Street and Scotland Street, where the Harvey Engineering Company Limited's works now stand, and built a little shed or workshop which had a few small tools and some smiths' fires, also a small brass foundry. There they started business as P. & W. MCONIE, Engineers and Millwrights, in the year 1845; and before long they were busy with repairs for the Trinidad estates. The engineer there sent home such complete sketches with all sizes carefully marked, that PETER MCONIE, who was a very clever, hard working engineer, had no difficulty in carrying out the instructions; and the prices were so moderate compared with those of the rival firm of D. COOK & CO., at whose works all the machinery had been made, that he secured all the orders for repairs from the proprietors of the estates, Messrs. STIRLING & GORDON, who were wealthy West Indian merchants. The Trinidad engineer was highly pleased with the careful manner and the good workmanship with which PETER MCONIE did the jobs; and when he knew that a complete new engine and sugar mill must soon be ordered for one of his estates, he made careful drawings of the set he required and sent them home to MCONIE, who started at once to make working drawings from the sketches, until at last he had all complete and was in a position to tender for the plant.

When the order was sent home for the new machinery, PETER MCONIE called at Messrs. Stirling & Gordon's Glasgow office desiring to submit to them an estimate; but the people there were very doubtful as to his ability to construct the machinery, as he had had no experience in such work. However they allowed him to send in his tender, and the price was so far below that of Messrs. COOK that they then seriously considered the matter, and on Mr. MCONIE explaining that he had working drawings already made to sketches from D. Cook's engine and sugar mill in Trinidad, they gave him the order.

When the first sugar mill of P. & W. MCONIE'S was about half complete, they found their capital was exhausted, and WILLIAM MCONIE thought his £1000 was lost; but Peter said it would be all right if they could secure more working capital. William, however, wished to have his money returned, so they inserted an advertisement in the *Glasgow Herald*, stating that a partner with capital was desired in the business. This advertisement came under the notice of Mr. MIRRLEES, who had a well established business as a saddler in Buchanan Street. He therefore called at the works of the brothers McOnie, and had an interview with them as to terms and conditions. Mr. MIRRLEES explained that he had come not on his own behalf, but on that of his son, JAMES MIRRLEES, who was in his own business as book-keeper, and who had had a good education, so that his father wished a more extensive sphere for his abilities than that of a saddler. It was, therefore, finally arranged that young JAMES MIRRLEES should become the commercial partner in the business, his father putting sufficient capital into it to give him a half interest in the firm. This allowed WILLIAM MCONIE to recover his original capital and to carry on, on his own account, the brass foundry part of the business, an agreement being made that he should make all the brass castings for the new firm of McOnie & Mirrlees.

With the additional capital the works were improved and some new tools added; and in a few years the business, which was confined to the construction of sugar machinery, did very well.

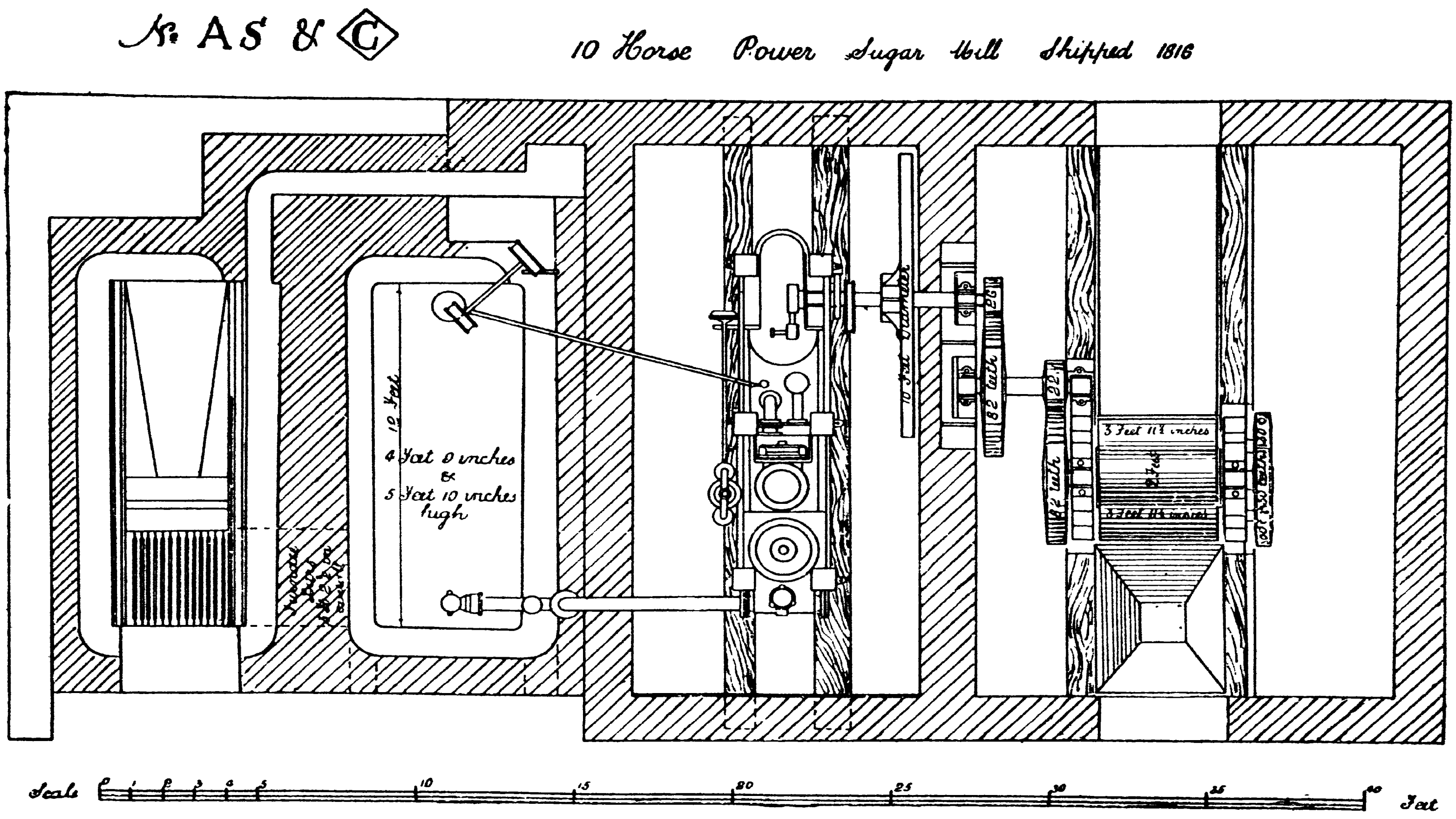
PETER MCONIE was a strong supporter of the "Free Kirk," and when not working late was attending meetings of the "Kirk Session;" but he must have overwrought himself, for he took fever and died suddenly in the year 1851.

PETER MCONIE had appointed his younger brother Andrew as manager of the firm, McOnie & Mirrlees, and it was a very natural expectation that Mr. MIRRLEES should have selected the latter, who knew the business well, to take the place of the deceased partner; but for some unknown reason the choice fell on Mr. WILLIAM TAIT, who was manager along with Mr. ROBERT HARVEY at Messrs. Neilson & Company's works, Hydepark Street, and who as already stated, acquired his knowledge of sugar machinery from Mr. HARVEY. Thus, in 1851, the firm became Mirrlees & Tait.

The works at that time were situated on the north side of Scotland Street and West Street corner, now occupied by the Harvey Engineering Company, Limited. Under Mr. TAIT'S management the business increased to such an extent that new and larger works were necessary, and about the year 1854 a large piece of ground was secured on the south side of Scotland Street and further west, extending from the railway line down to Scotland Street, as at present. These new works were built up-to-date in every way and fitted with the best tools and other machinery for their special line of business, the construction of sugar machinery.

Mr. WILLIAM TAIT was a very energetic engineer, and travelled throughout the West Indies, and coming in touch with the planters on the spot, learned their requirements. In consequence the business prospered exceedingly; but subsequently Mr. TAIT'S health began to fail, and he could give little attention to his work.

Mr. MIRRLEES made the acquaintance of the late Sir RENNY WATSON through Mrs. WATSON, who had been at the same school as Mrs. MIRRLEES. WATSON



Plan of a Sugar Mill made in 1816 by James Cook, Engineer, of Glasgow.

was an engineer trained more especially in constructing textile machinery, and had an office in Glasgow as agent in Scotland for Messrs. Mather & Platt, of Manchester. As Mr. MIRRLEES was not a trained engineer, in Mr. TAIT'S absence, he frequently turned for help to his friend, Mr. WATSON, who became so useful as an adviser that he was invited to remove his office to rooms at the works. He accepted the offer; and eventually, after Mr. TAIT'S death, became managing partner with Mr. MIRRLEES. The firm were then styled Mirrlees, Tait & Watson, and shortly afterwards Mirrlees, Watson & Company; and when they purchased the Yaryan Patents the name was again altered to the Mirrlees, Watson & Yaryan Company, Limited. Mr. YARYAN was an American, and the patentee of the Yaryan Evaporator, of which the firm made a large number.

Mr. WATSON was given a knighthood for the very valuable services he rendered in the founding of the Victoria Infirmary on the south side of the river. After his death the designation of the company was changed to The Mirrlees Watson Company, Limited, as at present. When the firm were Mirrlees, Watson & Company in Mr. WATSON'S time, they bought the American patents of Mr. WESTON for centrifugal machines used in the drying of sugar; and this turned out to be a very profitable branch of their business, as the Weston patent centrifugal machine was a great improvement on any other machine used for this purpose, and a special department was instituted for its construction.

The new department was in the immediate charge of Mr. JOHN LAIDLAW, an able engineer and mechanic. This line of the business continued to increase, whereupon Mr. WATSON decided to build new works at Dundas Street near to their present works for this special branch of the business, to be run as a separate company, all the partners of Mirrlees, Watson & Company being partners with Mr. JOHN LAIDLAW as managing partner. The latest knowledge and skill were embodied in these new works, which, under Mr. LAIDLAW'S able management, were most successful.

In time the various partners gradually retired, leaving him sole owner of the works, to which he made large extensions by securing additional land, on which he erected buildings and machinery suitable to turn out his speciality of centrifugal machines. The firm was subsequently converted by him into a private limited company under the title of Watson, Laidlaw & Company, Limited.

Later on, the principal draughtsman for Messrs. Watson, Laidlaw & Co. was Mr. WILLIAMSON. He, together with Mr. POTT, a traveller for the firm who had received his training in their employ, set up business for himself. In conjunction with Mr. CASSELS, the three partners built new works at Motherwell near Glasgow, and there under the title of Messrs. Pott, Cassels & Williamson they started work as iron founders and makers of centrifugal machines on similar lines to those of Messrs. Watson, Laidlaw & Company, Limited.

In the year 1851, when Mr. MIRRLEES adopted Mr. TAIT as his managing partner, Mr. ANDREW MCONIE left Mr. Mirrlees' employment. WILLIAM MCONIE had been very successful in his brass foundry business. As ANDREW MCONIE was a good engineer and had mastered all the details of the sugar machinery business of McOnie & Mirrlees, he suggested to his elder brother William that they should establish a joint concern as sugar machinery engineers. As William now perceived that there was money to be made in this particular line, he agreed, and they erected works at the corner of West Street and the south side of Scotland Street, where the Harvey Engineering Company's works now stand, and directly opposite to Messrs. McOnie & Mirrlees. The firm became W. & A. McOnie, Engineers and Millwrights. There was some confusion between the two firms as to their letters, etc., owing to the name McONIE being in both firms before Mr. TAIT joined, but this gradually subsided, and there was plenty of work for both firms and both were very successful. Later on Mr. THOMAS AITKEN, who had had been manager of the firm of W. & A. McOnie, was taken into partnership, and a few years later Mr. WILLIAM McONIE, Junr., the only son of WILLIAM McONIE, also became a partner. Then ANDREW McONIE'S son ANDREW became a partner, so that there were five partners in all; but not long after Mr. AITKEN retired from the firm and founded an engineering establishment in Govan along with JOHN McNEIL, who had been chief draughtsman with W. & A. McOnie, the firm being styled Aitken & McNeil, Sugar Machinery Engineers. When Mr. AITKEN died his son succeeded his father as a partner in the firm, but a few years later he retired to become a consulting sugar engineer in Glasgow, and the name of the firm was changed to John McNeil & Company, now John McNeil & Company, Limited.

The next retirements from the firm of W. & A. McOnie were those of ANDREW McONIE and his son. Then WILLIAM McONIE and his son William remained the only two partners, and the firm became W. & W. McOnie. Mr. McONIE, Junr., the son, died about 1887, and in 1888 the old sugar machinery business of JAMES COOK, as carried on by the father and afterwards by ROBERT HARVEY, the son, was amalgamated with the McOnie business as McOnie, Harvey & Company as already stated.

Shortly after his retirement from the firm ANDREW McONIE died. His two sons, Andrew and Peter, thereupon established works in Govan, about 1902, as A. & P. W. McOnie, Sugar Machinery Engineers; and it was again the confusion of the name of McOnie being in two firms in the same line of business that was the reason why the name of the firm of McOnie, Harvey & Company, Limited, was changed to the Harvey Engineering Company, Limited.

In Paisley about the year 1840 Mr. SMITH had a small engineering workshop which he carried on along with four sons, all engineers. They did a good business, but the sons wished to extend it, so they came to Glasgow. The eldest son, Alexander, along with his brother William as commercial partner, secured ground on the south side of the river at the corner of West Street and Gloucester Street, and built engineering works there, the firm becoming A. and W. Smith & Company. The other three brothers, James, Hugh, and Osborn, started tool and machine making works at Kinning Park, the firm being Smith Brothers & Company. Later Hugh left the firm and started with his sons the Possill Engine Works on the north side of the city, doing a large business in machine tools for shipbuilding yards. A. and W. Smith & Company were general engineers, and did a large special business as makers of platform weighing machines.

During a very busy season in the works of W. & A. McOnie, when that firm was exporting small cattle sugar mills by the hundred to the Philippine Islands in the East Indies, to keep pace with these orders they gave out a number of these mills to be made for them to A. and W. Smith & Company. It was thus that the firm began making sugar machinery, and later on they secured as manager a Mr. FRAME, of the firm of Mirrlees & Tait, in order to go more thoroughly into the business, and WILLIAM SMITH travelled to both the East and West Indies for orders, and thereby they built up a very good business in this special branch of engineering.

WILLIAM SMITH retired, and the business was carried on by ALEXANDER SMITH and his three sons. When the father died the sons carried on the business for a year or two, but subsequently was formed into a limited company, under the title of A. and W. Smith & Company, Limited, and has since continued to carry on a very successful sugar machinery business.

DUNCAN STEWART's father was engineer to Mr. CRUM-EWING at his calico print works at Thornliebank, near Glasgow, where the repairing and engineering works were of considerable size, and his son Duncan served his apprenticeship as an engineer there. He afterwards went to the West Indies as engineer on Ewing's sugar estates, where he acquired practical experience in sugar making and sugar machinery. On his return home he started a small factory in the east end of the city, which was repeatedly extended until it became the large concern of to-day that is known as Duncan Stewart & Company, Limited, who are noted for sugar machinery, marine engines, and all kinds of calico printing machinery.

From this narrative it will be seen that JAMES COOK was the founder of the sugar machinery industry in Glasgow, and his business is still continued by the Harvey Engineering Company, Ltd.; and that PETER MCONIE, the founder of the firm P. & W. McOnie and of McOnie & Mirrlees, afterwards Mirrlees, Watson & Company, Limited, began his career as a sugar machinery engineer by executing repairs for Cook's machinery from sketches sent home to him from the West Indies. From Mirrlees Watson & Company branched off the firm of Watson Laidlaw & Company, Limited, and from this firm that of Messrs. Pott Cassels & Williamson, Motherwell. The managing partner of the firm of W. & A. McOnie was ANDREW MCONIE, who acquired his knowledge of sugar machinery under his elder brother, Peter, in the firm of McOnie & Mirrlees. From W. & A. McOnie came the firm of Aitken & McNeil, now John McNeil & Company, Limited, Govan. Also from W. & A. McOnie came the firm of A. & P. W. McOnie, the two sons of ANDREW MCONIE, and nephews of Sir WILLIAM MCONIE. These works are also situated in Govan.

JAMES COOK built the first marine engine on the Clyde in 1816, also the first sugar mill driven by steam engine, and to-day Glasgow and the river Clyde are the chief centres of the marine engineering, shipbuilding, and sugar machinery industries in the Empire.

The Queensland Sugar Experiment Stations.[1]

The 1915-16 Season.

The severe drought experienced in 1915 caused a serious shortage in Australia which had to be made up with importations of foreign sugar. In that year Queensland turned out 140,496 tons, New South Wales 19,185 tons, and Victoria 560 tons, all of which left a deficiency of about 100,000 tons. This drought also affected the 1916 crop in many districts; but good rains fell during the autumn, winter, and spring months in the districts affected, so that the canes commenced to make more rapid growth, and the crops were materially increased.

The estimates of the crops formed at the commencement of the season showed that if all the mills had worked full time and been supplied with the estimated amount of available cane, there would have been some 1,748,900 tons crushed, equivalent to 205,752 tons of sugar (at 8·5 tons to 1); but owing to the enforced closing down of some of the mills for a period of nearly two months and the failure of three mills to start at all, the estimate of the total available amount of cane was reduced (in November) to 1,516,700 tons, though the actual figure would only be known when the year's crushing was completed. The sugar content of the cane, it is observed, has been adversely affected by the moist nature of the season.

---

[1] Abridged from the Sixteenth Annual Report of the Bureau of Sugar Experiment Stations, issued last November at Brisbane.

The work of the General Superintendent and Field Assistant has continued upon the same lines as laid down in previous reports. In addition to the advising of growers on methods of cultivation, manuring, and rotation of crops, observations have also been made by the Field Assistant upon sugar farms generally, comprising notes on soils and their testing for alkalinity and acidity, details of crops, use of lime, green manures and fertilizers, drainage, irrigation, notes on weather, ploughing, planting, cultivation, harvesting, ratooning, labour, pests, varieties of cane, arrowing of cane, disposal of trash, etc. But the work was hampered by the fact that Mr. EASTERBY had to undertake extra duties on a Government Inquiry Board, while his assistant, Mr. GIBSON, enlisted with the Australian Forces for the war. During the year new varieties of cane were introduced from Mauritius, Java, and Fiji.

MACKAY.

At the Mackay Station, which is under the able care of Mr. McCREADY, the chemist in charge, the experimental cane work is for the present largely confined to the testing of the new Papuan canes introduced in 1912, which occupy so much of the available land at the Station that there is not much space left for other purposes. These canes were providing their first ratoon crop; weather conditions interfered with the early stages of their growth, but the latter part of the season has been all that could be desired, and as a consequence the canes made good growth and some of the varieties produced a heavier yield than with the plant crop. A few of these canes indeed show promise, and if this is continued in the second ratoons and they prove free from disease, such canes will be distributed. Most of them are, however, of a thin spindly nature, giving exceedingly low analytical results, and under present conditions will not be of any economic value. However, if only two or three new species are secured, the collection and testing of these varieties will have been well worth while.

The following new cultural experiments have been initiated:—

(1) *Tests to determine the effect of fertilizer on plant crops and its action on succeeding ratoon crops.*—The fact has been frequently noted that where land has been treated with lime and green manure, the subsequent application of fertilizers has not increased the yield notably. When the cost of the manures is taken into consideration the fact cannot be overlooked that the fertilizing of a plant crop may not be a paying proposition as far as the plant crop itself is concerned. But as extremely payable results are obtained in the succeeding ratoon crops, the question arises: Is the action of the manure alone responsible for this increase, or does the application of fertilizer to plant cane result in a more vigorous stooling and in consequence, being of higher vitality, cause it to throw a stronger and more robust ratoon? To provide an answer, suitable experiments have been begun.

(2) *Tests to determine the value of subsoiling ratoon crops.*—The method of ratooning cane in vogue at this Station may be briefly described as follows:—Centres of drills are split with a swing plough and subsoiled, the stools are then cut away from and also subsoiled, manure is applied to the stools, and the centres immediately worked down with scuffler. As this method is somewhat slow and the cost of cultivation has now to be seriously studied, in some cases where the cane is not under experiment, such as that for propagation and distribution purposes, the ratooning has been confined to simply loosening the soil. In some cases the only treatment received has been a deep double cultivation with the riding spring tooth cultivator. In watching the results the latter method has often compared favourably with the former, and it may be that a well fertilized

cane stool growing on ground which has been previously deeply cultivated before planting may possess sufficient vitality to produce a flourishing ratoon crop without further treatment other than a loosening of the surface hardpan. In this connexion the following results will be of interest:—

From second ratoons of New Guinea 24B (half an acre in extent) originally subsoiled for the plant crop, a yield at the rate of 33·6 tons of cane was obtained. The ratooning consisted of a double stroke of the spring tooth cultivator, and beyond the application of fertilizers and ordinary scarifyings nothing further was done. These results are satisfactory.

In the preparation of land for planting it has been frequently noticed that where land has previously been subsoiled, the subsoil, even after a lapse of as long as four years, is of a considerably more friable and porous nature than where no subsoiling has been given. This is borne out when rain falls, as during harvesting often great trouble is experienced through teams bogging on such land. On subsoiled ground, apparently, the only setting of the land occurs in the first 9 in. of soil, whilst below this depth the soil is in a comparatively loose condition. As the point is of considerable value in lowering the cost of production, it fully justifies experiment.

Further experiments with the use of arsenical sprays for the destruction of weeds only confirmed the conclusion that the most troublesome weeds to eradicate do not succumb to the sprays, and the method is too costly.

BUNDABERG.

Mr. JAMES PRINGLE is the chemist in charge of the Bundaberg Sugar Experiment Station, and the present appearance of the place is stated to reflect great credit on his energy and care. Work during the season under review was, however, greatly hampered by the severe drought, the rains not putting in an appearance till the best of the growing season was over. As a consequence, it was decided to let the experimental canes stand over till the following season.

In experiments continued to test different methods of ratooning (the treated crops being second ratoons) the cane plot which was allowed to "volunteer through trash" proved the most prominent, and it suggests that this method is well worth trying in droughty seasons. Another series of experiments to test the advantages of potash manure only (in the form of 2 cwt. of sulphate of potash) *versus* no manure on a cane crop resulted in an additional increase of 5·25 tons of cane per acre being secured by the use of the potash.

At this station new experiments on a large field scale have been laid down to test the yields of cane planted by hand *versus* cane planted by the horse machine; also plots to test the efficacy of subsequent intertillage between the cane rows against no such subsequent cultivation.

LABORATORY WORK.

The work of the laboratories in connexion with the sugar experiment stations is of the utmost importance and an intimate connexion exists between the results obtained in the laboratories and those of the field. In addition to this, a great deal of useful work is performed for growers in the free analysis of soils, waters, fertilizers, sugar canes, etc., and of sugars for millers. At Mackay the laboratory has been kept fully employed throughout the year, 895 samples having been analysed, and 1669 analyses made. The Bundaberg laboratory is only equipped for sugar cane testing, but here 241 samples were analysed and some 486 analyses altogether were undertaken. Part of the staff of the Bureau is located at the Agricultural laboratory at Brisbane, and here a good variety of analyses is dealt with.

ENTOMOLOGICAL WORK.

The entomological work of the Bureau is still in the capable hands of Mr. EDMUND JARVIS. His work has included the control of the cane beetle, *Lepidiota albohirta* Waterh., the most destructive of the Queensland root-eating scarabaeid beetles affecting sugar cane. Field experiments of the egg stage on the whole proved unsatisfactory, resulting in the discovery of a single batch of eggs after close examination of about 150 cub. ft. of soil. Research work in connexion with the use of larvicides was initiated in February, 1915, when a number of insecticidal solutions were applied to cages containing the larvæ with varying results. Although of secondary importance, there are times when limited areas of grossly infested soil may be profitably treated in this way. The following chemicals were found to exhibit apparent larvicidal effects worthy of mention:—(1) Creolin (1 pint to 50 gallons water) proved fatal to 100 per cent. of larvæ 24 hours after treatment; 5 quarts of this solution were applied to the roots of a stool of cane at the laboratory without injuriously affecting the foliage. (2) Cyanide of potassium (1 lb. to 200 gallons water) destroyed 100 per cent. of larvæ in cages of soil and also in the field; a cane plant, 2 ft. high, watered with 8 quarts of this solution, showed slight signs of wilting after 24 hours, but regained its normal appearance a week or so later. (3) Borax (1 lb. to 3 gallons water) proved efficient, but is too expensive for general purposes. (4) Creosote (8 ozs. to 5 gallons water) emulsified with "Sunlight" soap gave fair results. Solutions of the following chemicals applied to soil in cages had no perceptible effect on larvæ of *albohirta*: Saltpetre (1 lb. to 3 gallons water), barium chloride (1 lb. to 3 gallons water), hellebore (1 lb. to 12 gallons water).

The great importance of control by means of stomach poisons was recognized from the start and kept in view throughout the course of preliminary research work initiated last season.[1]

The results obtained by recent experimentation are embodied in Bulletin No. 4 of this Bureau (Division of Entomology), entitled "On the Value of Poison Bait for controlling Cane Grubs," which deals comprehensively with the preparation, application, and economic value of two kinds of bait composed of cowpea foliage treated with cheap arsenical poisons.

The results as summarized were as follows:—

(1) Grubs will readily devour cowpea leaves dusted with aceto-arsenite of copper (Paris green) or with arsenious acid.

(2) Such foliage when treated with the former and buried 6 in. deep remains palatable and deadly in the ground for about a month.

(3) Two cage experiments with copper arsenite bait gave a mortality of from 90 to 100 per cent. of grubs in 16 days, while the poison diluted with three times its weight of stale flour yielded a mortality of 100 per cent. in 25 days.

(4) Similar cage experiments with arsenious acid bait yielded 100 per cent. of dead grubs in 14 days, the bait retaining its efficiency underground for at least one month.

It was proposed to apply the bait by sowing cowpeas in a single line 1 ft. from stools about three weeks after the first general emergence of the beetle, and as soon as the peas produced a row of stocky plants, 6 in. high, to dust same with the arsenical and plough them under in such manner as to bury the poisoned leaves against the main roots of the cane, where grubs when moving through the soil would be most likely to meet with them. The total cost per acre for labour and material was estimated at about 12s. 6d., or possibly 10s., in the event of farmers deciding to grow their own cowpeas.

---

[1] See *I.S.J.*, 1916, 427.

This plan of procedure relates solely to treatment of the late crop, planted in August or September, the intention being to combat the grub as far as possible during its second stage, at a time when young plant and ratoon cane would not be high enough to interfere with the necessary field work.

For the control of the beetle itself an original acetylene-light trap was invented and met with some success.[1] A trial also in using attractive odours resembling those associated with the chief plant foods of the beetle was encouraging enough to warrant further search being made in that direction.

ECONOMICS.

From the Report of the Government Statistician for 1916, it appears that the area in Queensland under cane in 1915 was 153,027 acres, of which only 94,459 supplied cane for crushing. This was the largest area cultivated during the past five years, except 1914, but was the smallest area from which cane was cut for the mill for the same period save 1912. The amount of cane harvested from this area was 1,152,516 tons, a decrease from the previous year of 770,117 tons. 140,496 tons of sugar were manufactured, or 85,351 tons less than 1914. Due to the abnormal drought conditions, 1915 was the worst year since 1902 in the yield of cane per acre, the average for the State being only 12·2. The yield of sugar per acre was 1·49, a slightly better figure than 1912. The highest average yield was 18·10 tons cane and 1·98 tons sugar in those districts south of Gympie, where the drought was not so severe. The lowest yield of cane per acre was at Ayr, being 10·45 tons. This district usually is in a high position in cane tonnage. Mackay yields were also very low, as were Bundaberg and Childers. The sugar content of the cane last year, however, was particularly good, and a ton of sugar was manufactured from 8·2 tons of cane on the average, a lower figure than at any period heretofore.

In the present condition of affairs it is impossible to say what mills will work continuously through the present season. It seems definite that some at any rate will not open, while others will not work through the whole of the crushing season. Provided that conditions will go favourably with the industry in future, it is a great drawback to the production of sugar that the existing mills are not kept more fully supplied. As pointed out in the Report of the Board to inquire into the position of the sugar industry, there is now sufficient milling power in Australia to manufacture 355,000 tons of sugar in a good year. Apart from climatic conditions, however, it is found that the southern sugar mills are at present not getting more than 52 per cent. of their full capacity, and more cane could also be grown for many of the northern mills.

The present consumption of sugar in Australia is now estimated to be 260,000 tons, with a yearly increase of 5000 tons so long as the population maintains its present state of progression. It is seldom, however, that anything like the tonnage of sugar required in Australia is made within its boundaries. The estimated value of the raw sugar crop in Queensland for the 1915 season at £18 per ton was £2,528,928. The value of the by-product, molasses, is not accurately known. Steps are being taken to make better use of this material, much of which has hitherto run to waste. It is noteworthy that a factory for the manufacture from maize of glucose, a sugar substitute used in making confectionery, has been erected and is in operation in Melbourne.

---

[1] For details see *I.S.J.*, 1916, 426.

Sugar-House Condensing Systems.

By FRANK COXON.

(Continued from page 70.)

WATER COOLING ARRANGEMENTS.

When the factory is so situated as to have a poor supply of water, some cooling device is necessary to cool down the condensate from the temperature it leaves the condenser to one as low as possible for re-condensing. The various arrangements used take three forms: towers, ponds, and sprays.

Towers.—These are generally of two designs, Cuban and rectangular, but both are to be found of timber as well as of steel construction. Cuban towers are usually in the form of "A" frames, some 15 to 25 ft. high, 2 to 4 ft. wide at top and 14 to 16 ft. at bottom, having a length to suit the capacity required, which is sometimes 300 ft. Cross-bearers are fitted and brushwood and planking placed on it to form a timber grillage. A perforated gutter usually runs the whole length of the top, fed at convenient points from a pump drawing from the hot well or reservoir for condensate, and the water running through the perforations, splashes on to the brushwood thereby presenting a large surface to the atmosphere. The other form of tower is usually not so long but wider to make up the capacity.

In general practice the "A" frame type is more usually employed, being more efficient, the partly saturated and warmed air getting away immediately, whereas in the squarer type it has to traverse a much longer passage in getting away and does very little work after half-way through. Frequently this latter type of tower can be seen with a distributing device in place of the perforated gutter and consisting of a number of spraying nozzles. These nozzles are not intended to break up the water into fine spray but merely in the form of heavy rain, giving a much more even distribution than the gutter which often as not lets the water down in sheets. The division of the water into fine spray at this level would of course be disastrous, it being simply blown away unless adequate provision is made for many feet around to collect the spray as it falls.

The cubic contents of the towers for a stated quantity of water varies considerably, and as much as 300 cub. ft. for every 1000 gallons of water per hour is found, whilst one as low as 180 has come to the writer's notice. In a matter of this kind over capacity can have no serious disadvantage except in that a little more make-up would be necessary.

Cooling ponds.—A poor method of cooling sometimes used is to discharge the water from the hot well into a distant pond of shallow but wide dimensions, presenting a large surface to the air. The water in the pond is arranged to overflow into one or more similar ponds and by reason of the long contact of its surface exposed to the air, it is thereby cooled. Little can be said in favour of this system and it is only practicable where natural sites for such facilities are available.

Spraying or Atomizing Nozzles.—An old form of cooling consists in using spraying nozzles which atomize the water into fine particles, practically in the form of mist Distributing pipes are laid over a pond, and at suitable intervals the nozzles are screwed in. Very little head is required to perform this work, and beyond friction in the numerous distribution pipes little more than 10 ft. or say 5 lbs. per sq. in. is required.

The spraying system, however, is entirely dependent upon the use of fine straining arrangements at the pump suction, a point not given the attention it deserves. The strainers in the form of fine wire gauze should preferably be removable, and be four in number, two fine and two coarse. They should work in guides, vertically, and be placed to divide the hot well so that the pump feeding the sprays gets clean water only. One of each mesh should be up for cleaning, and there should be facilities provided for the proper lifting and lowering.

Quite a number of otherwise efficient spray systems have been condemned simply for want of a reliable and easily worked method of cleaning and straining.

Readers of American sugar journals will have seen that the spraying system is being boomed to no small extent; its success, however, for such it is now, being entirely due to efficiency in this latter point.

It is not uncommon practice to use condensers that are arranged to deliver the tail water at such a height that the water is allowed to run by gravity to the top of the cooling tower, which means about 30 ft. All connexions to the condenser, vapour, air, and water will of course be increased in length as regards piping to this extent, and the water supply pump will have to deliver against this extra head. It must be remembered, however, that a pumping unit will have been eliminated, i.e., that one used to pump the water to the top of the tower from the hot well in the ground. This may mean practically the same power consumption, but the overall efficiency is increased, due to the use of one large unit in place of two small ones.

A novel form of combination is now in use in Cuba, consisting of this high level discharge arrangement feeding a set of low level sprays. A cooling tower is however provided, and when there is a loss of efficiency due to the sprays becoming choked, or more cooling water is required through increase in water consumption, the overflow or extra condensate is by-passed to the cooling tower, falling from the barometric leg by gravity.

A word here with regard to cooling tower work and the proportions of the accessory plant will be useful; both the air pump and water pump should be of ample capacity when dealing with condensing plant working with cooling towers. The temperature of the discharge water from the cooling tower is always much higher than that from a river supply, and this brings in its train a greater volume of incondensible gases, both from increase in temperature and from an extra quantity of water being necessary due to the higher initial temperature of the water and its inability to absorb the same units of heat per lb.

GENERAL COMPARISONS.

It will be interesting now to see how the four systems mentioned compare as regards:—

(1) Power consumption;
(2) Water consumption;
(3) Maintenance and other costs;
(4) Overall utility.

Taking the case of a factory dealing with 1000 tons of cane per day, there would be, say,—

Three vacuum pans, each of 800 sq. ft. H.S.

At 10 lbs. per sq. ft. $= 3 \times 10 \times 800 = 24{,}000$ lbs. vacuum per hour.

The quadruple would have 14,000 H.S.

At 5 lbs. per sq. ft. $= \frac{14{,}000}{4} \times 5 = 17{,}500$ lbs. per hour.

For central work the B.H.P. would be:

$\frac{17{,}500 + 24{,}000}{1000} \times 6$ (B.H.P. per 1000 lbs.) $= 240$ B.H.P. *Wet System*

and $\frac{17{,}500 + 24{,}000}{1000} \times 2\frac{1}{2}$ (B.H.P. per 1000 lbs.) $= 100$ B.H.P. *Dry*,

to which must be added the power to deliver the water to the condenser,

$$\frac{(17{,}500 + 24{,}000) \times 45 \text{ ratio} \times 30 \text{ ft. head}}{60 \times 33{,}000} \times \frac{100}{60} \text{ pump efficiency} = 46 \text{ B.H.P.}$$

Adding $100 + 46 = 146$ B.H.P. *Dry Reciprocating System.*

A *Rotary Air Pump* for similar duty would take approximately 140 B.H.P., to which must be also added either the extraction pump if low level, or water supply pump if barometer type.

140 + 46 = 186 B.H.P. *Rotary Air.*

The *Rotary Condenser* would take possibly a little more than this, but improvements in the design appear to be capable of accomplishing quite as much work as the rotary air pump and its water pump for the same expenditure of power.

Many people still look upon the steam cylinders in a factory as simple reducing valves, the proportion of heat abstracted by condensation in piping and cylinders being small compared to the total heat available for evaporating purposes. The time is past, however, for this kind of thing, and the order of the day is economical consumption in every case, for although exhaust steam may be required, it does not pay to make it through extensive pipe lines and steam cylinders, a point easily ascertained by practical experience from converting these so-called reducing valves to high-class engines using economical distribution valve gear.

The horse-powers computed therefore give some indication of what proportion of condensation losses can be saved in this respect when it is considered that of the total steam consumption from the boilers 10 to 15 per cent. is used up in general radiation and condensation losses throughout the factory.

As regards the electric driving of rotary machines the same also applies, for although the consumption of the generators is on more economical lines than that of a vacuum pump, pipe diameters are increased for the extra load, as is also cylinder condensation, both due to the extra power taken. It is therefore obvious that the rotary pump for sugar factory work has still to be developed on the lines of more efficient power consumption.

Water Consumption.—As already pointed out, the wet single jet system using displacement pumps can generally be put down at a ratio of 60 to 1, whilst the barometric would take an average of 45 to 1. The Leblanc low level and Rees rotary condenser can show a little better result than this, and in the same terms can come down to 40 to 1. In both cases this is due to the fine state of subdivision the water goes through, and thus the vapour thoroughly gets to every particle. The best of barometric condensers cannot give this fine division obtained in these latter two types, and it is a common thing to find the tail water as low in temperature as 4° below the vacuum temperature.

Maintenance.—It would be difficult to come to any decided decision on maintenance alone in connexion with the wet and dry systems of the reciprocating pattern, for whilst the many rubber valves of the wet pump require frequent attention the centrifugal water pump is an additional unit in the dry system, and through this there is very little to choose between them under this heading. The rotary system however can naturally claim some great advantages here in their freedom from moving parts and valves.

Overall Utility.—It is a very difficult matter to say which system holds the greatest number of advantageous points, and it is not within the writer's province to give a definite opinion,[1] but in conclusion it may be said that some form or other of rotary motion to the air pump in combination with low level condensation will in time become quite common, although at the present time there are so many items making the combination not readily adaptable to the sugar-house and its present need for high efficiency.

---

[1] There are many conditions at the site to be taken into consideration when existing installation conversions are being contemplated. Generally for fair sized plants the barometric system is universal and necessary for all estates troubled in fuel consumption, and as regards new installations no other would be entertained for one moment above a duty of about 6000 lbs. per hour.

Studies in Cane Sugar Manufacture.

INVESTIGATIONS ON PROCESSES IN WHICH THE TOTAL CLARIFIED JUICE IS PASSED THROUGH FILTER-PRESSES.

By CHARLES FRIBOURG.

In our previous article on this subject,[1] we stated that by the use of kieselguhr in the maximum proportions of 2·5 kg. per 1000 litres it was possible to effect the total direct filtration of the sulphi-defecated juice by means of filter-presses; and further that by concurrently employing 1–2 kg. of di-calcium phosphate, clarification was improved a little, and filtration was facilitated. We also stated that Mr. VLADIMIR GUERRERO, the inventor of "Phospho-gelose," had arrived at the same conclusions as we, since his product contains as its principal constituents kieselguhr and di-calcium phosphate, though at the time we ignored the proportions.

Since then we have had the opportunity of employing "Phospho-gelose," first in experiments on the small scale, and later in the factory with large quantities. We now propose to publish a certain number of experiments chosen among the many executed in arriving at the conclusions stated above, hoping thus to interest particularly our colleagues of the cane sugar industry. As one will remark, our experiments, owing to the prevailing circumstances, were always carried out with juices having every grade of purity, varying from 70° to 88°, that is to say, of low as well as of high degree. This point is of great interest when new processes are on trial, for, in general, with juices of very high purity, work is relatively easy, but one cannot say whether it will be the same with juices of naturally low purity, that is, those resulting from frozen or burnt cane. On the contrary, a process that operates well with juices of low purity will behave so much the better with juices of high purity, while necessarily using less of the clarifying agent.

PLANT FOR THE SMALL SCALE EXPERIMENTS.

In order to carry out the experiments on the small scale, and be under conditions very closely resembling industrial practice, the following plant was used: (1) a cylindrical tank, of about 60 litres capacity, provided with a mixer, for use for the treatment of the sulphited juices by clarifying agents in the cold, viz., lime, phosphate, etc.; (2) three small defecators of copper, furnished with an internal stirrer, a heating arrangement in the bottom, and an outlet cock communicating with a pump to a filter-press; and (3) a filter-press with juice and scum chambers, the dimensions of which were 0·155 × 0·155 m. with an actual surface of 0·120 × 0·120 m., and 15 m. thickness, the filtering surface of the press being 0·120 × 0·120 × 8 = 0·1150 sq. metre. Near the frame of the press there was a pump with a safety valve.

DIRECT FILTRATION THROUGH PRESSES USING KIESELGUHR.

First we will give an example of filtration, using kieselguhr alone. The juice operated upon came from a mill, which with maceration gave an extraction of 92 per cent. of the sucrose of the cane; and it was sulphited in a Quarez apparatus, the natural acidity of 0·40 grm. (as CaO) per litre being raised to 1·0 grm., while the purity, namely 76·3°, was relatively low. 50 litres of this juice were limed to neutrality in the cold, and treated with 125 grm. of kieselguhr, that is to say, at the rate of 2·5 kg. per 1000 litres of juice. Defecation was afterwards carried out by raising the temperature to boiling point *with movement*, that is to say, while constantly using the stirrer to prevent the formation of a surface layer and distribute the insoluble matters uniformly throughout. Subsequently the juice was passed through the filter-press, this taking 5 hours for a volume of 45 litres. The analyses of the juice were as follows:—

---

[1] *I S J*, 1914, 276–282; and 1914, 360–367.

	Weight per litre.	Brix, by weight	Brix, by volume.	Sugar, per 100 c.c.	Purity.	Glucose, per 100 c.c.	Glucose, per 100 of sugar	Lime (CaO), per 100 of sugar,	Acidity per litre.
Sulphited juice.	1·0668	16·43	17·54	13·39	76·3	1·88	14·80	—	1gr.000
Filtered juice..	1·0719	17·59	18·87	14·35	76·0	1·96	13·70	0·63	0gr.050

The filtrate was very bright, and contained only 0·63 grm. of lime (CaO) per 100 parts of sugar, which is a little less than that obtained practically with ordinary sulphi-defecation with special lime treatment for the scums and bottoms according to the purity. In general, one may have a difference of purity of 0·7°–1·0° between the juice put into process and the total filtered. Here, then, is an advantage of direct filtration by means of kieselguhr, besides the simplicity of work and the economy of labour and of steam. One separates in a single operation the treated juices into pressed scums, which may be washed slightly by known means, and into filtered juices, which may be submitted to a second filtration in Philippe filters, which thus fill the rôle of corrective filters, that is to say, their true rôle. The very compact scums obtained contained 60 per cent. of water; their weight was 1·170 grms., that is, 26 kg. per 1000 litres of juice (or 10·4 kg. of the dry scums per 1000 litres of juice). As regards filtering surface, it was calculated that one may pass the juice from 2 tons of cane in 24 hours through a square metre of filtering surface with good mill extraction. As an illustration, it may be stated that in a factory crushing 600 tons of cane in 24 hours it would require 300 sq. metres, or 20 ordinary filter-presses of 0·65 × 0·65 m. (or 0·50 × 0·50 m. actually), each having 30 chambers. It is certain that this surface could be decreased with high purity juices, so that with those of 86°–88° purity the presses would be filled in half the time, and the filtration would be twice as rapid. It would suffice then to have 150 sq. metres, or 10 presses for 600 tons.

Experiments on Sulphi-phosphitation.

When we had established that kieselguhr used alone made possible the direct filtration of sulphi-defecated juices, and this solely by reason of its physical action, that is to say, the admixture of the gelatinous precipitate from defecation with the very voluminous grainy matter, further experiments were carried out in order to study the effect of phosphoric acid and different phosphates.

For a number of years past phosphates, concentrated superphosphates of high content, or special preparations, such as "Ehrmannite," "Clarifine," and soluble phosphates, as well as concentrated phosphoric acid, have been employed in sugar factories. Such products contain almost all their phosphoric acid in a form soluble in water. As one will see later on, during the course of our investigations we have been brought to disregard these, and to confine ourselves to di-calcium phosphate, which is insoluble in water, in order to carry out direct filtration through presses.

EXPERIMENTS WITH SOLUBLE PHOSPHATES.

Here, first of all, is the analysis of two of these products, the one a concentrated superphosphate, utilized as manure in colonial countries, or else for the phosphatation of cane juices; while the other is a soluble acid phosphate, recommended for the treatment of juice:—

		Concentrated Superphosphate. Per cent.		*Acid Phosphate* Per cent.
Water		Undermined	....	44·45
Insoluble in acids		Undermined	....	0·20
Phosphoric acid		41·92	....	40·32
Soluble in water	35·92		37·76	
Soluble in citrate	41·92		39·04	
Total	41·92		40·32	
Sulphuric acid		3·46	...	0·98
Ferric oxide		1·34	....	1·26
Total lime		13·13	.	9·27
Undetermined matter		—	....	3·52
				100·00
Calcium sulphate, calculated		5·88		1·67

As pure mono-calcium phosphate, $CaH_4 (PO_4)_2 + H_2O$, has the centesimal composition,

	Per cent.
Phosphoric acid (P_2O_5)	56·35
Lime (CaO)	22·22
Total water ($3\ H_2O$)	21·43
	100·00

it may thus be concluded (1) that the acid phosphate is a mixture of about equal parts of mono-calcium phosphate and a solution of phosphoric acid of about 33 per cent., containing, however, a little di-calcium phosphate and calcium sulphate; and (2) that the concentrated superphosphate is an analogous product, but contains a greater proportion of di-calcium phosphate and of calcium sulphate. For use in the sugar factory, preference should be accorded to the product containing the least calcium sulphate; and accordingly it was with the acid phosphate that we have conducted the experiments.

LABORATORY EXPERIMENTS.

A milk of this acid phosphate containing 250 grms. per litre (that is, 1 grm. per 4 c.c.) was prepared, and it was used at the rate of 1 kg. and 2 kg. per 1000 litres of juice. The acidity of the juice was 0·35 before sulphitation; 0·86 after sulphitation; and 1·00 after phosphatation.

Experiment 1.

Test 1.—1 kg. of phosphate per 1000 litres of juice was used; 5 litres of the sulphited and phosphated juice were limed to give an alkalinity (in the cold) of 0·2000; defecated hot with movement; and filtered through paper, 20 mins. being required, and 90 grms. of pressed scums being obtained.

Test 2.—This was operated in the same way as the preceding test, except that the juice was limed to an alkalinity of 0·250. Filtration also required 20 mins., and 120 grms. of pressed scums were obtained.

Analysis of the Juices.

	Sulphited.	Test 1, Filtered.	Test 2, Filtered.
Brix (by volume)	19·18	19·60	19·83
Sugar, per 100 c.c.	14·84	15·21	15·44
Purity	77·4	77·6	77·9
Glucose, per 100 c.c.	1·88	1·92	1·96
Glucose ratio	12·70	12·60	12·70
Ash, per 100 c.c.	0·43	0·53	0·51
Saline ratio	34·5	28·70	30·30
Lime (CaO) per 100 of sugar	—	0·40	0·39
Acidity, per litre	see above	0·120	neutral

Experiment 2.

Here 2 kg. of the phosphate per 1000 litres of the juice were used. The acidity of the juices was 0·450 before sulphitation; 1·060 after sulphitation; and 1·340 after phosphatation. 5 litres of the sulphited and phosphated juice were limed to have an alkalinity of 0·300; filtration was good, the weight of scums was 160 grms., and the analysis of the juice was as follows:—

	Sulphited.	Treated and Filtered.
Brix, by volume	19·22	19·42
Sugar, per 100 c.c.	14·82	15·03
Purity	77·1	77·4
Glucose, per 100 c.c.	1·92	1·82
Glucose ratio	13·00	13·10
Ash, per 100 c.c.	0·50	0·54
Saline ratio	29·60	27·80
Lime (CaO), per 100 of sugar	—	0·36
Alkalinity, per litre	See above	0·100

From the results of these experiments it may be remarked that: (1) Phosphates (containing about 40 per cent. of phosphoric acid) increased the acidity of the juice about 0·140 per litre with the addition of 1 kg. per 1000 litres and 0·280 with that of 2 kg. per 1000 litres.

(2) After experiments repeated many times, we have arrived at the conclusion that a juice having an acidity of 0·300 to 0·400, raised to 0·800 to 0·900 by sulphitation should be limed to an alkalinity of about 0·050 (in the cold) in order to be sufficiently near neutrality after hot defecation and filtration; and that the same juice carried to an acidity of 1·100 to 1·200 by sulphitation should be limed to an alkalinity of 0·100 (in the cold) in order to arrive at the same point.

(3) By the use of acid phosphates, appreciably more lime is required to have a neutral filtered juice. Even when cold there is an absorption, and this increases gradually with heating. This amount of lime varies with the cane juices worked, and would seem to be three to five times the value of the phosphoric acid added.

(4) Phosphatation causes an increase of the purity, and juices of equal purity thus treated contain less lime than sulphi-defecated juices; while the saline ratios are higher.

Experiment 3.

Having verified these facts, and recognized an improvement in the rate of filtration by means of clarification with phosphate, though all the same gelatinous precipitates were obtained, we made some experiments with the use simultaneously of kieselguhr.

Test 1.—Phosphatation was carried out at the rate of 2 kg. per 1000 litres of juice, using 5 litres of juice, and 150 grms. of scums were obtained.

Test 2.—This was similarly operated, but kieselguhr to the amount of 2 kg. per 1000 litres was also added; 240 grms. of scums were obtained, and the results on analysis being as follows:—

	Sulphited.	Treated and Filtered.	Treated with the addition of Kieselguhr and Filtered.
Brix, by volume	18·50	18·15	18·23
Sugar, per 100 c.c.	14·28	14·25	14·32
Purity	77·2	78·5	78·3
Glucose ratio	11·40	11·30	11·30
Ash	0·53	0·61	0·64
Saline ratio	26·90	23·50	22·36
Lime (CaO), per 100 of sugar	—	0·40	0·51
Acidity, per litre	1·000	0·020	—
Alkalinity, per litre	—	—	0·100

Experiment 4.

In this experiment the amount of phosphate was diminished to 1·5 kg. per 1000 litres of juice, while also adding 2·5 kg. of kieselguhr. Filtration was more rapid than previously. From 5 litres of juice, 120 grms. of scums of better appearance were obtained. But there was no increase of the purity, and the difference between the saline ratios of the initial and clarified juices was near that of the effect of sulphi-defecation.

Experiment 5.

Other experiments were carried out, at first liming the sulphited juices and only adding the phosphate afterwards, that is to say, in an alkaline medium, in place of in a medium initially acid. The results, however, were analogous, and it would seem that in employing 1 grm. of phosphate per litre, the minimum quantity to have a visible increase of purity, it is necessary to use 4–5 grms. of kieselguhr to obtain scums likely to be filtered without pressure.

EXPERIMENTS WITH A FILTER-PRESS.

Experiment 1.

Phosphates alone, and at the rate of 1 kg. per 1000 litres of juice, were used with 50 litres of sulphited factory juice, phosphated, and limed, defecation being carried out hot and *with movement.* On attempting to pass the juice thus treated through a filter-press, filtration was very difficult. At the end of about 30 minutes, 10 litres had passed, and the pressure was already 3 kg. At the end of an hour and a half, it was 16 litres only with a pressure of 4 kg.; and at the end of 2 hours it was 19 litres with 5 kg. pressure. Finally, after 5 hours' working, 23 litres were obtained, the pressure being 5 kg., and the filter-press "gummed up." On opening the press, it was found that the chambers were but little filled, the scums being sticky, so that the experiments on the small scale were thus confirmed. With a juice having a purity of 70°–80°, it was noticed that the increase was 0·5° to 1·0°, with but little lime salts present. Hence, one will see that direct filtration through presses with the use solely of phosphates cannot be considered.

Experiment 2.

In this experiment the juice phosphated at the rate of 1 grm. per litre was treated with 1 to 2 grms. of kieselguhr. Filtration in the press was similar to that in the experiment without kieselguhr.

Experiment 3.

The amount of phosphate was decreased, and that of kieselguhr increased; and here are the results obtained with a juice of 80° purity. 50 litres of the sulphited factory juice were phosphated at the rate of 0·5 grm. per litre, limed and treated with 2·5 grm. of kieselguhr, after which filtration proceeded in the following way:—

Time	Volume, in litres.	Pressure, in kg
0 hours, 15 minutes	11	less than 2·0 kg.
0 ,, 50 ,,	17	2·5
1 ,, 10 ,,	22	4·0
1 ,, 30 ,,	28	4·0
3 ,, 0 ,,	33	4·0
4 ,, 0 ,,	36	4·0

Therefore, this is better, and approximates to filtration of the sulphi-defecated juice with kieselguhr alone. The scums had a good appearance at first sight, but were soft, and it was not possible to obtain a good weight. The analyses of the juice were as follows:—

	Sulphited	Filtered.
Brix, by volume	17·64	18·18
Sugar, per 100 c.c.	14·12	14·51
Purity	80·0	79·80
Glucose, per 100 c.c.	1·37	1·43
Glucose ratio	9·80	9·80
Ash	0·44	0·54
Saline ratio	32·10	26·90
Lime (CaO) per 100 of sugar	—	0·46
Acidity per litre	0·94	neutral

From all these experiments, the following facts may be deduced: (1) Total filtration through presses is possible with the sole addition to the sulphi-defecated juice of kieselguhr at the maximum of 2·5 kg. per 1000 litres.

(2) Filtration through presses is not possible in the case of sulphi-defecated juices treated solely with soluble phosphates, these producing a new gelatinous precipitate having the same inconveniences as that produced after defecation. Nevertheless, it is possible to notice an increase in the purity of the filtered juices, varying from 0·5° to 1·0° and even a little higher, according to the nature of the juice and the dose of phosphate. There is then, likewise, a diminution of the lime salts. This in no way means that soluble phosphate should not be employed. We have done so, adding them either before defecation, or to the clear juice of the defecators on elimination; but this means always a complication of the working of the defecation scums, and of the muddy liquids of the juice filters.

(3) Soluble phosphates may be used in small quantity to arrive at the direct filtration through presses by the simultaneous use of kieselguhr, but high proportions are required, such as have been stated in the experiments described. It was thus that we had the idea of trying the effect of a phosphate insoluble in water and incompletely neutral; and our choice fell naturally on the di-calcium phosphate, which is capable of absorbing an equivalent amount of a base to form a tribasic phosphate.[1]

Deficiency diseases, e.g , beri-beri, pellagra, it is stated by **ATHERTON SEIDELL**, of the Hygienic Laboratory, U.S. Public Health Service, are being treated successfully by a preparation of a suitable vitamine obtained from yeast. Washed, pressed and autolysed brewers' yeast is filtered and treated with Lloyd's colloidal aluminium silicate reagent, and the residue finally obtained after syphoning and desiccation is administered.

---

[1] Experiments dealing with the use of di-calcium phosphate and of "Phospho-gelose" will be described in the next issue.

The Employment of Electric Power in Sugar Factories.

By H. W. VAN DER LEE.[1]

(Specially translated by Ed. Koppeschaar.)

GENERATION OF ELECTRICAL CURRENT.

When a *metallic wire* (a conductor for electrical currents) is moved through a magnetic field,[2] a *potential* is created in this wire. This potential, the force which produces an electrical current, is called *electromotive force* (E.M.F.). The E.M.F. depends on *the velocity* with which the field is crossed by the conductor (the wire). In Fig. 1 the wire, *a b c d*, can wind round a shaft *M M*, and while rotating it crosses the lines of force, indicated by arrows. In the parts, *ab* and *cd*, which cross the lines, an electromotive force is generated, which may yield a current whose direction we can ascertain as follows:—

Holding the thumb of our right hand in the direction of the wire, the first finger is that of the lines of force. Then the middle finger indicates the direction of the current. If the wire moves as the dials of a clock, the E.M.F. moves in *ab* as indicated, in *cd* the reverse. The sections *ad* and *bc* do not cross the lines of force, and therefore no E.M.F. is generated in them.

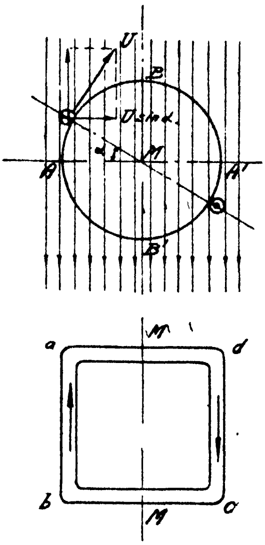


FIG. 1.

When the wire coincides with *AA'* no lines of force are crossed, and the E.M.F. is zero at that moment. Rotating further on, with an angle of 90°, when the winding is perpendicular to line *AA'*, the field is crossed by the perpendicular wire, and the E.M.F. at that point is largest. Rotating further 90° again, *A'A* is reached once more, and the E.M.F. will be zero again. The wire *ab*, however, will then have taken the stand of *cd*, as will be seen in the figure, and the current is just opposite of what it was in *ab*.

At the same moment *cd* has passed *A*, and again the direction of the current generated in it has been reversed. Recapitulating, we shall see that for one rotation of the winding, the E.M.F. grows from zero to a maximum, then diminishes to zero, changes its direction, grows to a negative maximum, to become zero once more.

When we resolve the velocity of the circumference of the winding at a given point where it makes a certain angle with line *AA'*, into two components, one in the direction of the lines of force, and the other perpendicular to the first (see Fig. 1), then the number of lines of force which are crossed by the wire will depend upon that component of the velocity which stands perpendicular upon them.

The horizontal component, parallel to the line *AA'*, equal to the E.M.F., stands in direct equation to the sine of the angle which was passed, starting from line *AA'*. The maximum value of the E.M.F. is equal to the product of the E.M.F. multiplied by the sine of the angle which it has passed through.

---

[1] In *Tydschrift*, 1915-16, Nos. 11, 12, and 13.

[2] This action may be studied by using a permanent magnet, iron filings, and a sheet of paper. The so-called magnetic lines of force will then be clearly seen.—[TRANSLATOR.]

In Fig. 2 a circle is shown with a radius equal to the maximum value of the E.M.F. A sine-line constructed from this circle shows the E.M.F. and how it continually changes, from zero, *A* (angle = zero, sine = zero) to maximum, *B*, and decreases gradually to *A'*, where it is zero again. Becoming negative, it reaches its maximum negative value at *B'*, and becomes zero again at *A*, where the same process is begun over again. The time needed to go through the whole cycle, until the moment that the *status quo ante* is reached, is called *a period.* A period amounts to, and coincides with, one revolution of the winding, or, in other words, with a traversed angle of 360° (electrical degrees).

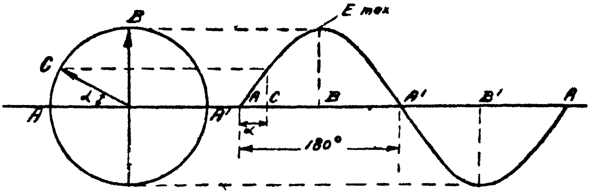


Fig. 2.

In Fig. 3 the winding is wound round an iron drum, which revolves between the north and south poles of a magnet, *N* and *Z*. Here the same reasoning holds good, and the E.M.F. will be largest at the centres of the poles, and zero when the winding stands perpendicular to the direction of the poles.

Alternating Currents and Machines.

That the currents created by the E.M.F. in these circuits are called *alternating* currents will be readily understood after the foregoing. With each complete rotation of the winding the direction of the current will be changed twice.

This current, alternating as it is created, may be tapped by simply cutting the winding in the centre of *bc* into two, and uniting the two ends thus formed with two slip rings. Brushes resting on these slip rings and connected with a wire will conduct the current (see Fig. 3). We may thus put the current to various uses.

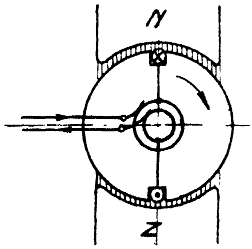


Fig. 3.

For instance, we may generate light with it, by making use of the property of a carbon thread or metallic filament which offers such a resistance to the passage of the current, that it is set aglow, and consequently gives off light.

By using currents at 50 periods per second (in which the direction of the current will change 100 times within a second) the human eye is insensible to the numerous vibrations of the light caused by the sine-line variation of the E.M.F. Fifty periods per second means that the wire, the circuit, the winding, the armature, or other conductor in which the current may be generated, must pass a north magnetic pole 50 times per second, and also 50 times a south pole. If only one north and one south pole are present, the armature, the rotor, must make 50 revs. per sec., amounting to 3000 revs. per min.

The modern steam-turbines do reach this speed, but for all the other power producers, such as steam-engines, gas and oil motors, a far lower speed is the rule.

Therefore dynamos producing alternating current, or alternators as they are called, are generally equipped with more than one pair of poles. Thus, in order to produce an alternating current of 50 periods per sec., this velocity will amount to :—

For an alternator with 1 pair of poles = 2 poles, revs. of armature 50 p.s. = 3000 p.m.
,, ,, ,, 2 ,, = 4 ,, ,, 25 p.s. = 1500 p.m.
,, ,, ,, 3 ,, = 6 ,, ,, 16·7 p.s. = 1000 p.m.
,, ,, ,, 4 ,, = 8 ,, ,, 12·5 p.s = 750 p.m.
and so on.

In large municipal power stations horizontal steam engines up to 2600 H.P. are used, coupled direct to alternators possessing 28 pairs of poles or 56 in all, and running at 1·8 rev. per sec. equal to 108 revs. per min.

ALTERNATORS WITH ROTATING MAGNETS.

When the slip rings are replaced by a collector or commutator, the brushes resting on the collector tap a direct current. The generators for this direct current, commonly called dynamos, are usually designed in such a way, that the magnet stands still while the winding or armature revolves. For alternators, however, the method is reversed; here the armature stands still, and the magnet revolves within it. The former is then called the stator, the latter the rotor.

No slip rings are necessary to tap the alternating current; instead, solid bars are employed. Where the armature is not revolving a very obvious advantage is obtained from the fact that the insulation (a very necessary factor where the potential often reaches 10,000 volts) will not be so easily damaged.

The poles of the magnet or rotor are not permanent, the magnet being built up of iron cores provided with windings. A direct current, sent through these coils, magnetizes the cores. This current is tapped by slip rings and brushes on the shaft, and is generated by a dynamo coupled to the same shaft.

The amount of energy thus needed to excite the generator should not exceed 5 per cent. of the power of the generator. Moreover, the voltage of this current is low, being usually 60 to 100 volts, so that the insulation does not need to be very elaborate. Thus in order to excite a generator of 100 kilowatts, an exciting dynamo of 5 kilowatts will be sufficient.

THREE-PHASE ALTERNATING CURRENT OR ROTATORY CURRENT.

The name *rotating current* is often misunderstood. In Fig. 4 an alternating generator is sketched, of the type universally constructed nowadays. The magnet, an artificial one, magnetized by an independent direct current, revolves in the centre, and is thus a rotor. The surrounding armature, in the combined circuits of which we desire to generate a current, stands still; it forms a stator. The magnet is equipped with only *one* pair of poles, which must therefore revolve 3000 times per min. in order to generate an alternating current of 50 periods per sec. The armature is equipped with three sets of coils in lieu of one (as in Fig. 3).

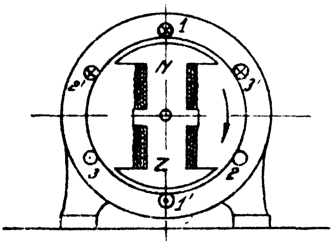


FIG. 4.

As the pole-wheel stands in the sketch, the maximum E.M.F. will be excited at *1-1'*. When the pole-wheel has rotated a further angle of 120°, the maximum E.M.F. will be excited in the coils *2-2'*. Still moving 120° further on, as indicated by the arrow, a maximum E.M.F. will be generated in coils *3-3'*.

For each one of these maximum E.M.F. Fig. 2 represents the sine line. When we unite the three lines for the three currents, Fig. 5 will represent their course. They will appear shifted one after the other. One such is called a phase.

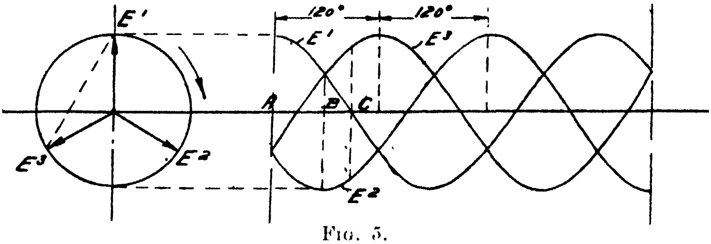
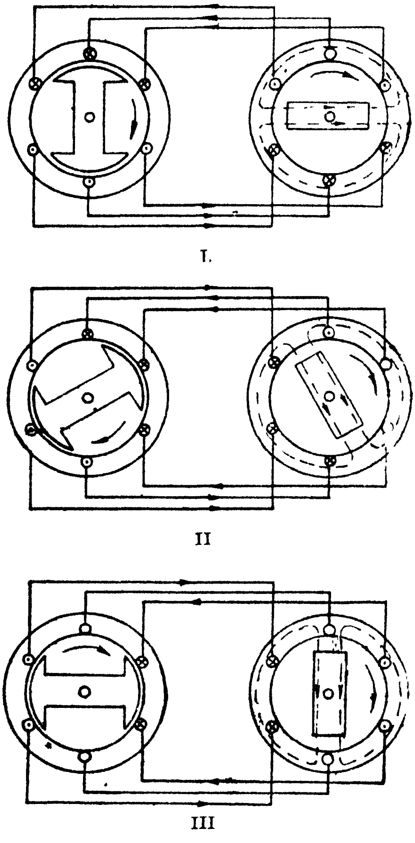


Fig. 5.

As soon as more than one circuit is present, there is more than one phase, when the current is graphically brought into line. In our case, Fig. 4, with three distinct coils, the current is called a *three-phase alternating current.*


I.

II

III

Fig. 6.

The polewheel shifts, while revolving, from *1* to *2*, from *2* to *3*, and from *3* to *1*, but the sets of coils, as will be noticed, are 60° apart. Hence, if the distances between the coils shift 90°, the result will be two-phase current, if 60° it will be three-phase current, if 30° six-phase current, and so on. In order to excite the maximum E.M.F., the polewheel must turn in the first case 90°, in the second case 120°, in the third case 150°, and so on. Thus currents of any number of phases could be devised, but for sound reasons the three-phase current has been chosen as the fittest.

Fig. 6 (left side) shows an alternating current generator, or rotating current generator, identical with the one in Fig. 4. From the sets of coils, *1-1'*, *2-2'*, *3-3'*, extend wires to corresponding coils in another machine, Fig. 6 (right side), with corresponding windings, and provided with a rotor. This machine on the right side represents a rotatory current motor.

When we follow the courses of the currents between the coils, *1-1'*, of both machines, representing a complete circuit, we see that where the maximum E.M.F. goes through *1* and *1'* on the generator, the same maximum E.M.F. will go through the corresponding points in the coils in the motor. In the other coils, *2* and *3*, of the generator, current will also be excited, and will create a magnetic field in the motor, as indicated by the dotted lines. The six wires making the winding of the stator from the motor form, at that moment, a magnetic winding round a horizontal shaft.

If a piece of iron be placed within the stator, which can revolve round a shaft through the centre, then, influenced by the magnetic field, it will take the position indicated. *II* gives the moment where the polewheel of the generator has turned 60°, and the poles are just opposite *3-3'*. The wires, *1*, *3'* and *2*, are now opposite the north pole, *1'*, *3* and *2'* opposite the south pole of the polewheel, giving a current as indicated. The direction of the magnetic field, excited by the currents in the motor, has changed as well, the centre of the imaginary magnetic winding formed by the six stator wires having shifted 60°. The soft-iron-core follows this shifting, and revolves 60° similarly. In *III* the polewheel of the generator has rotated further and stands perpendicular to the first situation. Only in *2-2'* and *3-3'* will currents be excited, while *1-1'* remains currentless. The corresponding process takes place in the motor, and the iron-core will again change its place, as indicated.

Thus the magnetic field continually changes and rotates. The terms *rotation field* and *rotatory current* are derived from it.

CONNEXIONS FOR ROTATORY CURRENTS.

The generator in Fig. 6 has three coils or circuits, independent of each other. In practice a manifold of three spools is provided, and each one is built up of a great number of wires. Thus a far greater efficiency is obtained. Three circuits, each with two terminal bars, have in all six terminals, connected with six corresponding terminals in the motor. In Fig. 7 these three circuits with their six terminals are given diagrammatically.

For lighting purposes the crosses show how lamps are inter-connected in the so-called six-wire system. A switchboard with bus bars distributes the current. A main wire connects the generator with these bars, furnished with main switches between machine and bars, in order to protect the machine against overload. From the bus bars the various wires tap the current to the motors, glow-lamps, etc., which wires in turn are protected also by safety fuses. For the six-wire systems, however, the switchboards and connexions would become too costly and complicated, and it is a simple matter to make the number of wires smaller.

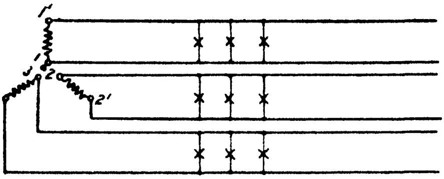


Fig. 7.

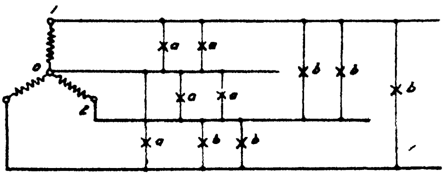


Fig. 8.

When we unite the starting points of the three windings to one terminal bar, a star-connexion is obtained (see Fig. 8). As the same voltage is excited in each of the windings, the same voltage will also exist between each of the terminals of the three-phase wires and the star centre, and we may connect lamps *a*, as indicated, between the phase wires which are connected with the outer terminals and the zero wire, connected with the star centre.

When the phase-wires are equally loaded, the total sum of the currents is zero, and therefore the return current will be zero as well. When they are unevenly loaded, the return current may be small, for which reason this zero wire is often made of small diameter. We may connect the lamps also, as it is done at *b*, without making use of the zero wire at all. The potential between the outer terminals is larger than that between one outer terminal and the star centre. If we call the latter the *star voltage*, then the combined potential between the outer terminals will mutually amount to $\sqrt{3}$ or 1·73 times the star voltage.

In Fig. 5 the star voltages are represented by the arrows E_1 E_2, E_3 of equal length, with 120° between them. The combined voltage is represented by the length of the connexion line between E_1 and E_3, equal to $\sqrt{3} \times E$. The length of E_1 also represents (see Fig. 5) the maximum value of the star voltage, as well as likewise the maximum value of the combined voltage.

Fig. 9 finally gives the three-corner connexion where the number of wires is reduced to three. The total of the currents generated in the three wires is, at any any moment, zero. Thus no circulating currents are created in the closed circuit. Generators, connected in three-corner, are equipped with only three terminal bars and no star centre. Generators connected in star may have three or four bars, depending on whether three or four wires are used. Of late the four-wire system has been given preference again for large centrals. A higher voltage saves wiring material.[1] In new centrals we find a star voltage of 220 volts for lamps, and a combined voltage 1·73 times as large, or 380 volts, for connecting with motors.

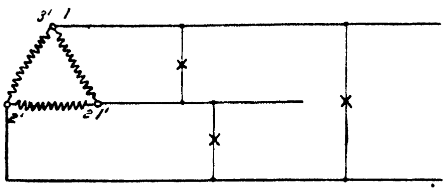


Fig. 9.

The zero wire is then connected with the earth, and the potential will not be higher than 220 volts, thus not offering any danger.

(To be continued.)

It was officially announced the other day that Lord DEVONPORT had been appointed Chairman of the Royal Commission on the Sugar Supply in the place of Mr. McKENNA. Two other vacancies on the Commission, caused by the retirement of two members of the late Government, have been filled by Mr. AUSTIN TAYLOR and Mr. GEORGE ERNEST MAY. Mr. TAYLOR, a retired Liverpool shipowner, is keenly interested in home beet sugar projects, while Mr. MAY is Secretary of the Prudential Insurance Co.

The recent restriction on the use of sugar for confectionery in the United Kingdom affects the sales at some 200,000 retail shops. In normal times about 400,000 tons of sugar are used per annum by the sugar-using industries of the kingdom, half of it by the sweetmeat and chocolate manufacturers.

A Report of the Laboratory of the Inland Revenue Department at Ottawa on fertilizers submitted for examination during 1916 shows that out of 365 samples, 330 were found to meet claims fully, 18 others met claims by "compensating value," while 8 were passed as being only just below standard. As regards those which possessed "compensating value," it was sufficiently evident that many manufacturers confounded the terms *available* and *soluble* as applied to phosphoric acid. But generally speaking there was evident a desire on the part of the manufacturers of fertilizers to live up to claims made; and it was noted that the claims for content in potash were in many cases reduced, in keeping doubtless with the scarcity of potash salts due to war conditions.

---

[1] According to the law of Ohm, $C = \frac{E}{R}$, the diam. of the wire can be made smaller. [Translator.]

Correspondence.

CONDENSING SYSTEMS.

To the Editor "The International Sugar Journal."

Dear Sir,—In reply to Mr. **Renton** regarding the ratio of expansion from atmospheric conditions to a vacuum or a lower absolute pressure than the atmosphere, I would suggest that neither Charles' law nor Boyle's law is correct taken singly, but all calculations should be done with a combination similar to the manner described by Mr. **Hamill** in his notes on "Air in Condensers."

For practical use it is quite sufficient when converting from atmosphere to vacuum in such calculations on the sugar estate, to use Boyle's law, and if one cares to go fine enough, to correct it with Charles' law. The volume of air from condensers has received no small attention from makers, especially with regard to the extraction of the air at a point near the entrance to the injection water inlet.

Mr. **Hamill's** article is particularly of value in this respect.

With regard to the statement that the volume of air for pipe calculations to be extracted will be 10 times the displacement of the pump, this is obviously an error, the volume being equal to the pump capacity.

What was intended to be said was that the amount of air by volume at atmospheric pressure would have to be corrected to allow for the expansion, and at the figures given to an extent of 10 to one.

Yours faithfully,

Frank Coxon.

Review of Current Technical Literature.[1]

The Soderlund and Boberg System of Evaporation by Thermo-Compression. *Anon. The Times Engineering Supplement, December 29th, 1916.*

In the new plant[2] in lieu of depending upon boiling under diminished pressure for the recovery of the latent heat of the vapours, the inventors rely upon a diametrically opposite method, and the latent heat is returned and utilized in the same evaporator to effect further evaporation. The rise in temperature is effected by mechanical compression of the vapours which is so far carried out as to give to the vapours evolved just sufficient increase of temperature to render them again available for causing additional volumes of liquid to boil under similar conditions in the same heating element. Thus, the vapour evolved by the liquid is rendered available as a heating medium merely by imparting to it, by mechanical means, the "step-up" of temperature needed for its re-use.

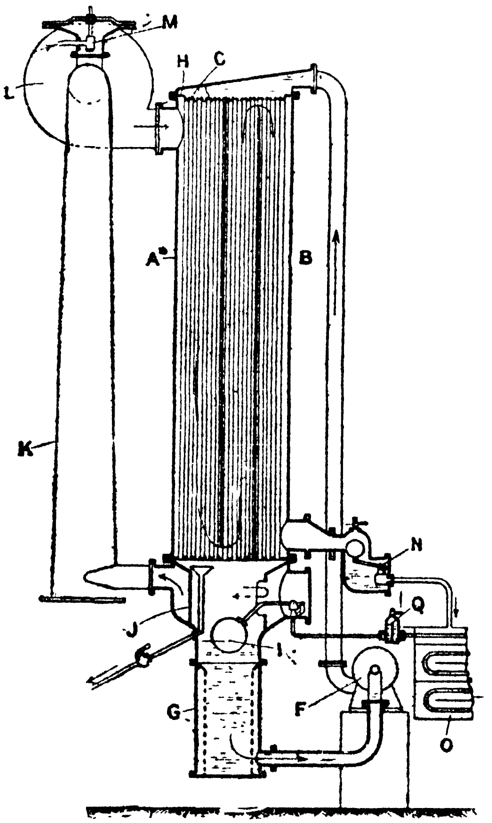
In order to follow out the method, it may be convenient to take a theoretical case in which water is boiling in the evaporator at atmospheric pressure. The steam having a temperature of 100° C. contains in every kg. 539 calories of latent heat. This steam is withdrawn and is compressed, so that its temperature is raised to $(100 + x)^\circ$ C. It is then passed back into the heating element, and is capable of being condensed upon the heating surfaces, because of its rise in temperature. In becoming condensed, it parts with its 539 calories of latent heat, which are transmitted to the liquid surrounding the heating element, and consequently effect the evaporation of some of this liquid. Here the recovery of the 539 calories becomes possible by the small number of calories imparted to the vapour by compression, or by the expenditure of the requisite amount of mechanical energy. This amount of energy may be represented by the multiple of x (the rise in temperature) and of the compression energy needed to raise 1 kg. of steam 1° C. in temperature, or the multiple of x calories and 1·4. The smaller the value of x the greater will be the economy of the process. Other important factors will be the power employed in compression, the heat rejected from the system in the hot condensate, and the radiation losses.

---

[1] This Review is copyright, and no part of it may be reproduced without permission.—(Editor, *I.S.J.*)

[2] *I.S.J.*, 1913, 344; 1914, 488, 576; 1915, 337, 1916, 195.

Unless the temperature difference between the boiling liquid and the heating steam is kept extremely low, there would be no economical advantage between the present system and many others of a similar character, because of the high power consumption for compressing. But if this difference can be reduced to 2° or 3° C., the process is bound to show excellent results. In the plant under notice the plan has been adopted of distributing the liquid upon the heating surfaces in the form of a film, and thereby difficulties with regard to the temperature-difference are overcome; for it is found that by causing the liquid undergoing evaporation to traverse the heating surface as a thin and rapidly moving film a difference of only 1° C. will in certain cases suffice, while the extreme range of temperature need not exceed 2° or 3° C. In all bulk and climbing film operations several degrees of temperature-difference must be devoted to the production of motion and ebullition in the liquid, but by the use of the film the working temperature-difference is restricted to that required for simple heat transfer. By means of a rotary compressor of good design an efficiency of 70 or even 75 per cent. can be attained, and the inventors employ the internal combustion engine for the production of the motive power.



When this system is used for the purpose of concentration, other conditions may come into play. It appears that in all these cases, due allowance being made for the higher boiling points when the liquid becomes more and more concentrated, the apparatus gives very economical results.

A plant on this system is being erected in Sweden for the recovery of the chemicals from the waste liquors from wood pulp manufacture, and it seems likely that the process may be available for the concentration of many varieties of trade-waste now considered incapable of treatment.

Description of the Evaporator.—In the accompanying diagram details are given of the plant as applied for simple purposes of distillation. The evaporator comprises a tall shell *A*, the greater portion of which is taken up by the calandria *B*. The tubes, *C*, have each a nozzle at the top for distributing the water. The liquid, which is raised by a pump *F*, from the lower portion *G*, of the shell *A*, is fed into the tray *H*, formed at the top of the calandria *B*, and, passing through the nozzle of each tube, is spread as a thin and rapidly moving sheet over the inner surface of the tubes *C*.

The liquid collects again at the bottom of the shell, fresh liquid being supplied by the constant level feed *I*, to be returned by the pump *F*, to the distributing tray *H*, at the top. The steam given off from the films on the insides of the tubes and separated from spray by the baffles *J*, in the base of the shell, and by the tangential disposition of the steam entry to the steam main *K*, leading to the compressor *L*, passes to the compressor. The required quantity of "make-up steam" is added to it on its way by a pressure-controlled automatic steam inlet, *M*. The compressed steam enters the space round the tubes *C*, and becoming condensed on them is drained off as hot water through a steam-trap *N*, connected to a counter-current regenerator *O*, through which the cold feed flows to the automatic feed valve *I*. The small volume of non-condensible gases which is not driven off from the feed liquid through the blow-off *Q*, at the hot end of the regenerator *O*, is cleared out of the steam space by periodically blowing off a little steam, or by permitting a small continuous leakage of steam out of this space. The compressor is driven at a constant speed by spur gear from a shaft-belt, which may be driven direct from a gas engine working, for instance, in connexion with a small suction-gas plant, or by an oil engine. The exhaust in either case passes to a small boiler generating the "make-up steam."

REPORT ON SUGAR: MODIFICATION OF THE ORIGINAL CLERGET DOUBLE POLARIZATION PROCESS; USE OF INVERTASE AS HYDROLYST IN THE DOUBLE POLARIZATION PROCESS. *C. A. Browne*. *Journal of the Association of Official Agricultural Chemists*, *1916*, *2*, *No. 3*, *134-143*.

Modification of the Original Clerget Double Polarization Method.—In the original Clerget process the sugar solution is diluted with the hydrochloric acid used for inversion from 50 to 55 c.c., whereas in the Herzfeld modification the dilution is from 50 to 100 c.c., so that errors of reading are in the first case increased by only one-tenth, but in the second are doubled. Notwithstanding this advantage in favour of the old procedure, the experience of chemists has indicated that it possesses a certain unreliability, one cause of which has been the neglect of the very serious point of considering the diminution of volume of the 55 c.c. taking place during inversion, this being due to: (1) the contraction on inversion, which for 13 grms. in 55 c.c. is about 0·25 c.c.; (2) the increase of temperature on adding the hydrochloric acid, namely about 3·0° C.; and (3) the evaporation of water from the neck of the flask during inversion, this depending upon the diameter of the neck of the flask, the time and the temperature of inversion. Now the combined influence of the three factors causes the volume of the 55 c.c. of solution at the end of inversion to be about 0·33 c.c. too small, using the half-normal weight of 13 grms.

These sources of error, Dr. BROWNE points out, are easily overcome by making up the volume to 55 c.c. *after* and not before inversion, more accurate results thus being secured than by any modification involving diluting to 100 c.c. Inversion may be carried out at room temperature, details of the proposed procedure being as follows:—

Using a 50–55 c.c. flask, 5 c.c. of concentrated hydrochloric acid are added to 50 c.c. of the sugar solution, and after standing at laboratory temperature overnight the volume is completed at 20° C. exactly to 55 c.c., the solution being mixed and read also at 20° C. During inversion the temperature is controlled by a thermometer placed in a similar flask containing 55 c.c. of blank solution. After increasing the inversion reading by one-tenth, the percentage of sucrose is calculated by the following formula when the normal weight of 26 grms. has been used:—

$$S = \frac{100\ (A - B)}{144{\cdot}9 - \frac{t}{2}},$$

A and B being the direct and inversion readings respectively, and t the temperature of the thermometer. And this formula, corrected for differences in the specific rotation of invert sugar with varying concentration when less than 26 grms. per 100 c.c. are used, becomes:

$$S = \frac{100\ (A - B)}{144{\cdot}9 - \frac{t}{2} - 0{\cdot}01\left[144{\cdot}9 - \frac{t}{2} - (A - B)\right]},$$

which, if the temperature of observation of the inversion sending be 20°C., becomes:

$$S = \frac{100\ (A - B)}{134{\cdot}9 - 0{\cdot}01\ [134{\cdot}9 - (A - B)]}$$

Application of Modified Clerget Procedure to Solutions of Sucrose and Dextrose.

No.	Dextrose, grms. per 100 c c	Direct Polarization (A)	Invert Polarization (B) (corrected).	Temperature (t) °C.	Sucrose (S) per cent Found	Taken.
1	4·8	91·70	—11·88	20	76·96	76·92
2	4·8	72·45	— 5·06	20	57·70	57·69
3	4·8	53·15	+ 1·60	20	38·45	38·46
4	4·8	33·90	+ 8·20	20	19·23	19·23

Formula corrected for varying concentration.—That it is of importance to use a formula correcting for difference in the rotation due to the varying concentration may be seen from the above table in the case of No. 3 determination, which gave 38·45 per cent., but would have been 38·21 per cent., namely, 0·24 per cent. less, had the formula made no allowance for change of rotation with change of concentration. In this connexion Dr. BROWNE, as referee for sugar of the A.O.A.C., urges that the Association should adopt a modified Herzfeld formula, or the Herzfeld table of factors, in place of the uncorrected formula, now prescribed, and this should be done by means of the following formula, based upon the difference between the direct and invert polarizations:—

$$S = \frac{100\ (A - B)}{142{\cdot}66 - \frac{t}{2} - 0{\cdot}0065\left[142{\cdot}66 - \frac{t}{2} - (A - B)\right]},$$

which for 20°C. is simplified to:

$$S = \frac{100\ (A - B)}{132{\cdot}66 - 0{\cdot}0065\ [132{\cdot}66 - (A - B)]}$$

Use of Invertase as Hydrolyst.—In analysing mixtures of sucrose and invert sugar by the double polarization method, it is possible to correct by means of an empirical formula the error caused by the change in the specific rotation of the levulose due to the acid added; but such a method is not adapted to the examination of complex mixture of optically active substances. Of late, therefore, the efforts of chemists have been directed towards finding a method by which the direct and inversion readings can be made under similar conditions. Of the various methods that Dr. BROWNE has tested in this connexion, the one which has given the most satisfactory results is that using invertase as hydrolyst, following the procedure adopted by HUDSON.[1] It has been applied to solutions of sucrose and invert sugar, and the results show that it gives far more accurate results than the method of acid inversion for the purpose of commercial analysis. It requires care and watchfulness; the preparation of the invertase solution is somewhat troublesome, and a blank analysis upon a weighed amount of pure sucrose must be carried out with every set of determinations. Nevertheless the process is invaluable as a control upon the accuracy of the method of acid inversion, being therefore now recommended for adoption as a provisional method by the Association.

REPORT OF THE NEW YORK SUGAR TRADE LABORATORY FOR YEAR ENDING DECEMBER, 1916. ***C. A. Browne.*** *New York Sugar Trade Laboratory, Inc., 79, Wall Street, New York, U.S.A.*

Dr. BROWNE reports that, as in previous years,[2] the constant temperature laboratory for polarizing sugars at 20°C. (68°F.) has continued to give satisfactory service. The cost of operating the refrigerating machinery for 1916 was $127·65 for 1612 K.W. hours of electric current, and $10·63 for 10,630 cub. ft. of water for the condenser, making a total of $138·28, and artificial cooling was necessary upon 111 days. In addition to its regular routine, the laboratory has done work, as in previous years, upon certain research problems. The investigation of the causes, which influence the deterioration of raw sugars, has been continued, and a report of this work was presented before the September meeting of the American Chemical Society. During the year under review, altogether 22,334 samples of sugar were polarized, compared with 19,924 and 17,634 in 1915 and 1914 respectively, and the average reading was 95·30° as compared with 95·04° and 95·15° in the two previous years.

NOTE ON POLARIMETRIC READINGS. ***L. Baissac.*** *Bulletin de la Société des Chimistes de Maurice, 1916, 7, No. 4, 149.*

When examining a sugar solution in the saccharimeter, it very often happens that if after a first reading the tube containing the liquid be turned on its axis an angle of 90°, a second reading will differ from the first by several tenths of a degree, and sometimes the writer has observed differences of 0·4 and even 0 5. This is due to the glass cover discs not being absolutely parallel, so that the thickness of liquid is not the same with the two positions of the tube. It may also arise from the fact that the tube may not be quite in the optical axis of the saccharimeter, the copper trough not being properly set. It is recommended that two readings be always made, and that the mean of these be taken as the observation.

THE TOTAL DESTRUCTION OF PENTOSES DURING ALCOHOLIC FERMENTATION ***H. Pellet.*** *Comptes rendus, 1916, **163**, 274-276.*

If a mixture of 200 grms. of beet molasses and 1-2 grms. of arabinose or xylose in 1 litre of water is fermented by 5-10 grms. of top or bottom yeast at 28°-30° C., it is found, after 2-2½ days when all action has ceased, that 10-20 per cent. of the pentose has disappeared. If, on the other hand, instead of using only one lot of yeast, a fresh amount of 5 grms. is added each day, it is found that the whole of the pentose has been eliminated. By increasing the amount of the yeast added at the first to such an extent that the fermentation is complete at the end of 24 hours, none of the pentose is decomposed, but during a further lapse of time the pentose slowly disappears. With cane molasses the fermentation must be carried out in such a way that it is complete at the end of 6-12 hours, or there may be a loss of any pentose present. By this method the author has proved the presence of a reducing sugar, probably *glutose*, in cane molasses, which is not acted upon by yeast, whatever may be the amount used, or the duration of its action.

J. P. O.

---

[1] *I.S.J.*, 1910, 192

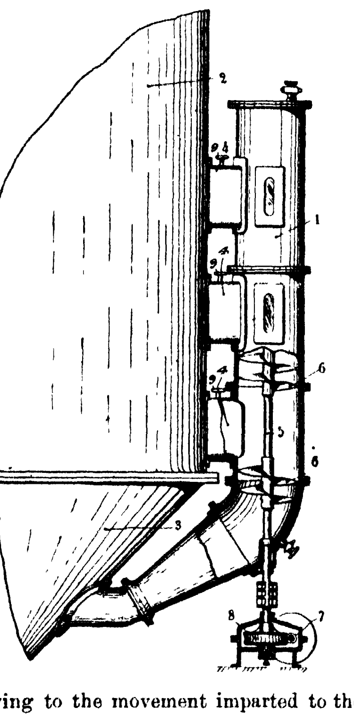
[2] 1915, 187; 1916, 286.

Review of Recent Patents.[1]

UNITED STATES.

CIRCULATING DEVICE FOR VACUUM PANS. *Auguste Krug,* of Etrépagny, Eure, France (Assignor to *La Société Anonyme des Etablissements Alfred Maguin,* of Charmes, near La Fere, France). *1,179,636.* Patented, April 18th, 1916.

As will be seen in the drawing, the circulating device is constituted essentially by a vertical tube *1* of cast-iron or any other suitable material provided at the side of the calender *2* of the boiling apparatus; the tube *1* being closed at its upper end and communicating at its lower portion at one or two points with the bottom part *3* of the vacuum pan. Further, the tube *1* communicates with the calender by means of a certain number of pipes *4*, while in the interior of the tube *1*, rotates a shaft *5* provided with helical blades *6*, *6'* situated between two of the communicating pipes *4* as shown in the drawing. The pipes *4* are arranged in such a manner as to correspond with the interior arrangement of the heating surface and with the different stages of the boiling operation; granulation, feeding rich syrups, and feeding syrup-water. The screw rotates at a suitable speed (generally 40 revs. per min.); movement being transmitted to it by any suitable arrangement, for example, as shown in the drawing, by a worm *7* and helicoidal gear-wheel *8*, while the worm may be driven by belt or by an electric motor.



The operation of the circulating device is as follows.—As soon as the boiling mass reaches the first communication pipe, the circulating device is put in operation. It will easily be seen that the mass which is moved downward by the first screw toward the bottom of the vacuum pan causes an energetic stirring in the latter. From this results a more rapid and more complete action on the mother-liquor as regards sugar crystals; in other words, the crystals form better and increase more quickly than in similar apparatus as known up to the present time. In proportion to its rise in the apparatus, the boiling mass reaches the level of the second and then of the third communicating pipe; it is then acted upon by the screws 6' and successive screws of the circulating device which discharge it downward. Movement consequently is set up right through the apparatus; the mixture is thus perfect, and crystallization very active owing to the movement imparted to the boiled mass which agitates the crystals formed at the middle of the mother-liquor

In order to avoid loss of heat, the circulating device may be surrounded by a non-conducting jacket; or a double steam jacket may also be provided for the same purpose. The pipes *4* may, as in the drawing, communicate freely with the interior of the vacuum pan, or be provided with closing devices, which allow, if necessary, of shutting off of the circulating device from the boiling apparatus. Instead of a single circulating device, two or a greater number may be provided at different points in the circumference of the boiling apparatus, when the diameter or arrangement of the latter requires it, in order to obtain energetic stirring in the interior of the boiling mass.

---

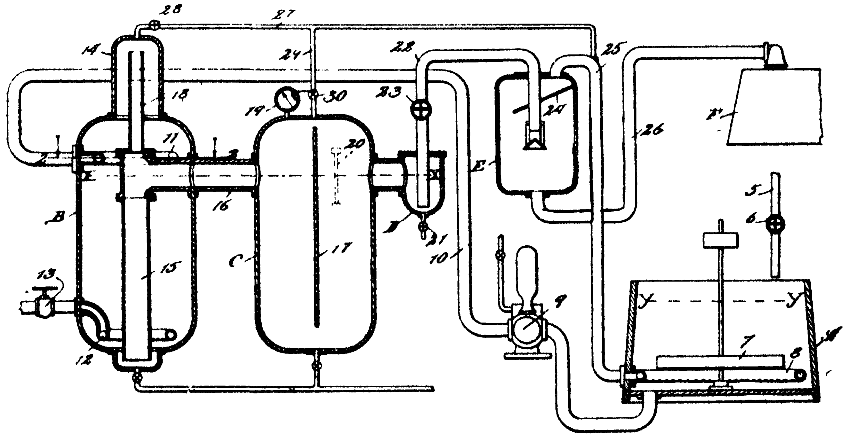
[1] Copies of specifications of patents with their drawings can be obtained on application to the following.—*United Kingdom:* Comptroller of the Patent Office, Southampton Buildings, Chancery Lane, London, W C (price, 6d each) *United States:* Commissioner of Patents, Washington, D C. (price 5 cents each). *France:* L'Imprimerie Nationale, 87, rue Vieille du Temple, Paris (price, 1 fr. 05 c. each). The date given in the heading of specifications is that of the application of the patent.

It is essential to keep the denser concentrates separate from the lighter ones, and only use the latter for stirring up the mother-liquor to modify the quality of the crystallization. This latter result is obtained by means of the regulating valves. It will be seen that the valves *9* can be used to control the circulation in various ways.

CONTINUOUS MANUFACTURE OF STARCH GLUCOSE OR ALLIED PRODUCTS. *Clarence L. Sovereign and Adolph W. H. Lenders*, of Waukegan, Ill. (Assignors to *The Corn Products Refining Co*, of New Jersey, U.S.A.). *1,183,408.* Patented May 16th, 1916.

In describing the process as "continuous," it is meant that the syrup is discharged, not in batches as has ordinarily been the case hitherto, but while the conversion of the unconverted starch is in progress, the fresh starch being similarly introduced to make up for the discharged product without interrupting the conversion taking place in the converters.

Referring to the illustration, the starch is continually supplied to a tank *A* through the pipe *5*, being first mixed with a suitable acid water. An agitator *7* may be employed to thoroughly mix the liquor in the tank *A* and to break up any lumps of starch. A steam coil *8* heats the liquor in the tank. From the tank *A* the liquor is pumped by the pump *9* through the pipe *10*, and perforated ring *11* into the converting vessel *B*, the latter being provided (preferably at the bottom) with the steam coil *12*, the supply of steam to which is controlled by valve *13*. Preferably the vessel *B* has the steam dome *14*. The liquor from the bottom of vessel *B* passes through a pipe *15* and into a cross-pipe *16*, which leads into the top of a second converting vessel *C*, which is preferably provided with the vertical partition *17* extending to within a short distance of the top and bottom of the vessel. A pipe *18*, open at the end, extends from pipe *16* up into the steam dome *14* of vessel *B*. Vessel *C* discharges into a blow-up pot *D*. A pipe *22*, controlled by valve *23*, leads from the bottom of the blow-up pot *D* into expansion chamber *E*, the latter being provided with the baffle plate *24*.



The liquor, it will be understood, is heated under considerable pressure in the converting vessels, in practice about 40 lbs., although this pressure may be varied. The apparatus will be so designed that the pressure in the expansion chamber will be very small, for example, 1 lb. The liquor going from the high pressure to the low pressure gives up a great deal of vapour, which is separated in the expansion chamber, the vapour going to the steam coil *8* in vessel *A* through the pipe *25*, the converted liquor passing from the bottom of the expansion chamber to the neutralizer *F* through pipe *26*. A steam pipe *27* leads from the steam dome of vessel *B* to pipe *25* and is provided with a valve *28*. A pipe *29*, having a valve *30*, connects vessel *C* with pipe *27*.

When the apparatus above described is started up, the priming water can first be heated in tank *A* and then be pumped into vessel *B*. After this the starch mixed with the acid water (for example, dilute hydrochloric acid) is heated and agitated in tank *A* and then pumped into vessel *B* until the desired level is reached, represented by line *X—X*. During this time the valves *28* and *30* are left open, giving a vent from the converting vessels. Steam is injected into the liquor in vessel *B* during the filling of the converters and escapes through pipes *27* and *29* into tank *A*, where it is utilized to heat the inflowing stream of liquor.

When the liquor in the converters has reached the normal operating level *X—X* the process by proper adjustment of the valves determined by testing at the test cock *21* will be carried on continuously. The acidified starch is supplied to tank *A*, so as to maintain a desired level *Y—Y* in this tank. The pump is so timed as to introduce just enough of the liquor into the converters to maintain the right level so that the vapour spaces above the liquor line are in communication throughout the apparatus, and so as to give a rate of flow which will insure a proper degree of conversion in the liquor discharged into the expansion chamber. The steam supplied can also be regulated to give a proper temperature and pressure. Valves *28* and *30* may be closed or partly closed. The discharge valve *23* can be set to regulate the outflow from the converters. When a proper regulation of the flow of liquor, steam pressure and temperature has been brought about, the product must necessarily be uniform, since the conditions governing the conversion are uniform.

UNITED KINGDOM.

CONTROL OF THE SUPPLY OF LIQUID TO CENTRIFUGALS. ***Herbert A. Wilson,*** of 1221, Lawrence Avenue, Chicago, U.S.A. *4008.* March 13th, 1915. Under International Convention, March 13th, 1914.

A speed controlled governor is provided for the regulation of the feed of liquid, this actuating a valve, which, however, opens only upon a predetermined speed of the machine being reached.

Referring to the illustration, the supply valve *17* has a guide *18* working in a tube *15*, and is connected by a link and lever to a rod *24*, which is actuated by the governor gear shown in Fig. 4. The machine shown is hand-driven, and an extension of an intermediate shaft *27* carries a disc *30* having spring-pulled governor weights *33*. Pins *40* on the weight arms *32* engage a collar *38* on a sliding sleeve *36* splined to the shaft *27*. This sleeve has two friction bevel-wheels *43*, *44* adapted to engage another bevel-wheel *45* on a shaft and running in a bearing *48*. The bevel-wheel *45* has a flat on its circumference, so that contact with the bevel-wheels *43*, *44* rotates it only about 180°.

FIG.2.

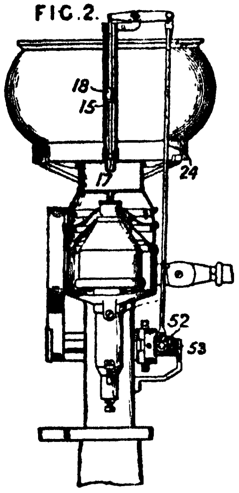
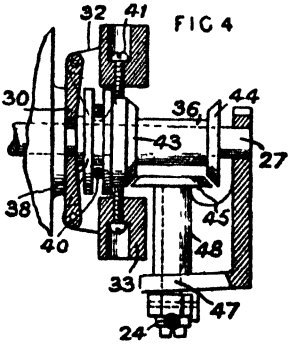


FIG 4



In operation, when the predetermined speed is reached, the weights fly outwards, and the sleeve *36* is moved so that the bevel-wheel *43* turns the bevel-wheel *45* and its shaft *47*.

A crank on the shaft *47* is connected to the valve-rod *24*, whereby the valve is opened. The reverse action takes place on the speed falling. Adjustable stops *41* are provided for the governor weights, and stops *52*, *53* limit the movement of the shaft *47*.

Machine for Harvesting or Digging Sugar Cane, or other Plants. *Hero N. van Dijk*, of 26, Verhulststraat, The Hague, Holland. *24,081*. December 15th, 1914. Under International Convention, December 15th, 1913.

A machine is described for harvesting or digging sugar cane and other plants also applicable for making furrows, comprising a tractor having supporting means mounted thereon to carry milling cutters and a plough share or plough shares and means driven from a motor on the tractor whereby the implement or implements (i e., the milling cutters and a plough share or plough shares) for operating on the soil is moved along the supporting means so that a length of soil may be operated on whilst the tractor is stationary, the tractor being then driven along so that a further stretch of soil may be treated.

As is shown in the figures, the motor *3* is mounted on a frame *2* supported by two side wheels *4* and a steering-wheel *5*. Supports *1*, in which members *6* carrying the tools move, are secured to the rear of the frame *2*. The motor drives the shafts of two independent friction clutches *9*, *10*, the clutch *9* being adapted to transmit power to a shaft *11*, which is connected through bevel-gearing *12* to gear-wheels *14* operating the running wheels *4*. The wheels *14* operate through a pawl device, so that the wheels *4* may move independently. The clutch *10* couples up the shaft *15*, which drives shafts *21*, *24* through bevel-gearing, the shaft *21* being connected by chain-and-sprocket gearing with a shaft *27* on which two chain-wheels *28* are mounted, which each drive an endless chain *29a* running over the rollers *29* on the end of the supports *1*. Each of the chains *29a* runs over two intermediate rollers *30* to a chain disc *31*, thus operating a milling-cutter *36*, which is adapted to loosen the soil at the side of the sugar cane roots.

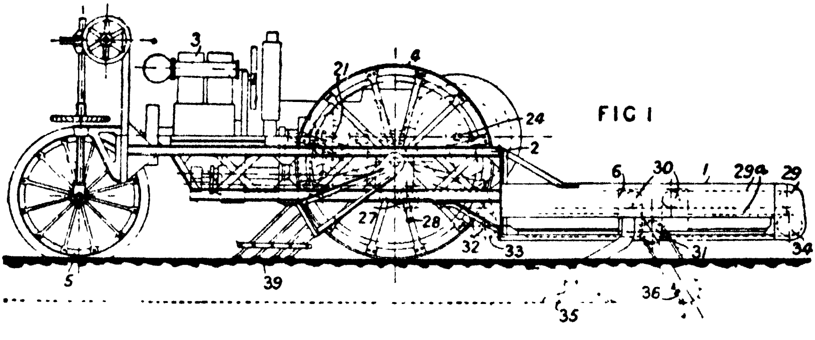


FIG 1

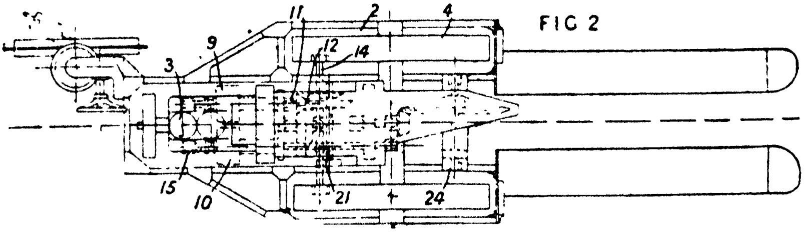


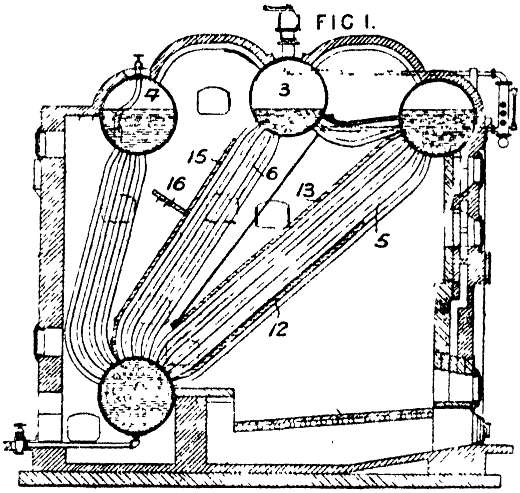
FIG 2

The shaft *24* operates through chain-and-sprocket gearing a shaft *32*, upon which are mounted two chain-wheels *33* driving chains passing over the rollers *34* and connected to the sliding tool supports *6*. The sprocket-wheels on the shafts *27*, *32* are driven through pawls, so that the tools are not operated when the motor is moved forward. In operation, the clutch *10* is thrown in, thus causing the milling-cutters *36* to rotate and to be moved from one end of the supports *1* to the other, the carriage being held steady by means of a brake *39*; the clutch *10* is then released and the clutch *9* put in, so that the machine is moved to bring a fresh stretch of ground below the supports *1*. A plough *35* may be attached to the members *6*.

The specification as open to inspection under Section 91 (3) (*a*) states also that one projecting tool support may be used; this subject-matter does not appear in the specification as accepted.

STIRLING STEAM BOILER. *Harold G. C. Fairweather*, of 65-66, Chancery Lane, London, W.C. (communicated by *The Babcock & Wilcox Co.*, of New York, U.S.A.). *23,986*. December 12th, 1914.

FIG I.



In Stirling boilers of the 4-drum three bank type with a primary combustion chamber unobstructed by an arch, made up by the side walls and the front wall of the furnace, the inventors provide a particular type of baffle extending in the direction of and in front of the major portion of the tubes of the front bank of tubes. With this arrangement the maximum amount of heat transmitted is secured from the products of combustion as they are brought into contact with the series or banks of water-tubes and directed there along, a more perfect combustion being promoted within the furnace than has hitherto been accomplished.

Fig. 1 shows one form of boiler in which the front baffle *12* is arranged behind the first row of tubes; other baffles *13*, *15*, *16* are arranged as shown. The baffle *12* may be formed entirely of the water-tubes, or it may enclose the tubes. A superheater may be arranged between the banks of the tubes *5*, *6*, and the baffles *13*, *15* may extend from the drums *3*, *4* to alter the direction of flow of the gases, additional baffles being provided.

FIG 8

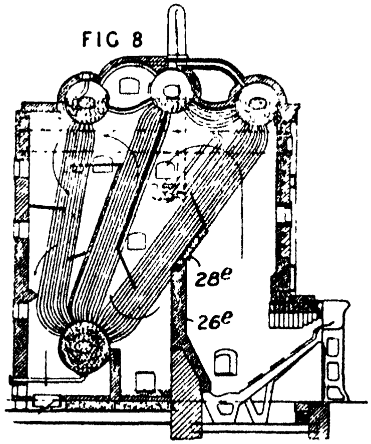


Fig. 8 shows another form of boiler in which the front baffle *28e* is formed as an extension of a vertical wall *26e*. The baffles are arranged to cause the gases to flow in the direction indicated by the arrows. A dust pocket is formed behind the wall *26e*.

BEET HARVESTING MACHINE. *T. V. Jensen*. *10,291*. July 21st, 1916; Denmark, July 3rd, 1915.

United Kingdom.

IMPORTS AND EXPORTS OF SUGAR.

IMPORTS.

	Month ending February 28th.		Two Months ending February 28th.	
Unrefined Sugars.	1916. Tons *	1917. Tons.*	1916 Tons *	1917. Tons.*
Russia	....	....	....	.
Germany	....	....	....	....
Netherlands	....	....	....	....
Belgium	....	...	...	...
France	....	....	....	....
Austria-Hungary	....	....	...	....
Java	....	60,779	9	147,349
Philippine Islands	....	762	7,570	778
Cuba	64,100	....	72,062	....
Dutch Guiana	....	332	853	649
Hayti and San Domingo	....	....	....	....
Mexico	....	....	....	....
Peru	1,483	6,119	9,250	11,645
Brazil	48	1,084	49	5,240
Mauritius	14,888	1,800	34,855	1,800
British India	....	....	....	....
Straits Settlements	....	....	....	....
British West Indies, British Guiana & British Honduras	330	2,534	2,457	5,194
Other Countries	377	4	1,137	4
Total Raw Sugars	**81,227**	**73,414**	**128,242**	**172,659**
Refined Sugars.				
Russia	....	....	.	....
Germany	....	...	....	....
Holland	62	...	4,251	....
Belgium	....	....	....	....
France	....	1	....	1
Austria-Hungary	. ..	....	.	....
Java	...	1,829	18	21,389
United States of America	15,157	1	50,888	27
Argentina	....	2	250	2
Mauritius	3,665	....	3,678	....
Other Countries	42	89	45	120
Total Refined Sugars	**18,926**	**1,922**	**59,131**	**21,539**
Molasses	2,817	5,425	11,691	14,353
Total Imports	**102,970**	**80,761**	**199,064**	**208,551**

EXPORTS.

British Refined Sugars.	Tons	Tons.	£	£
Denmark	....	...	....	....
Netherlands	....	....	.	....
Portugal, Azores, and Madeira	...	....	....	....
Italy	....	....	...	....
Canada	....	....	...	. .
Other Countries	539	128	1,888	273
	539	128	1,888	273
Foreign & Colonial Sugars.				
Refined and Candy	202	4	328	5
Unrefined	40	87	47	160
Various Mixed in Bond	....	....	....	....
Molasses	160	6	427	7
Total Exports	**941**	**225**	**2,690**	**445**

*** Calculated to the nearest ton.**

United States.

(Willett & Gray, &c.)

(Tons of 2,240 lbs.)	1917. Tons.	1916. Tons.
Total Receipts January 1st to February 21st	403,184	390,112
Receipts of Refined ,, ,,	—	—
Deliveries ,, ,,	408,205	386,589
Importers' Stocks, February 20th	5,944	7,601
Total Stocks, February 20th	192,494	98,371
Stocks in Cuba, February 20th	174,144	345,269
	1916.	1915.
Total Consumption for twelve months	3,658,607	3,801,531

Cuba.

STATEMENT OF TOTAL EXPORTS AND STOCKS OF SUGAR, 1914-1915, 1915-1916, AND 1916-1917.

(Tons of 2,240 lbs.)	1914-15 Tons.	1915 16. Tons	1916-17. Tons.
Exports	181,326	302,205	207,913
Stocks	123,702	212,527	186,665
	305,028	514,732	394,578
Local Consumption	7,820	8,200	9,700
Receipts at Ports to January 31st, 1917	312,848	522,932	404,278

Havana, January 31st, 1917. J. GUMA.—L. MEJER.

United Kingdom.

STATEMENT OF IMPORTS, EXPORTS, AND CONSUMPTION OF SUGAR FOR TWO MONTHS ENDING FEBRUARY 28TH, 1915, 1916, 1917.

	IMPORTS.			EXPORTS (Foreign).		
	1915 Tons	1916. Tons	1917. Tons	1915. Tons	1916. Tons.	1917 Tons.
Refined	126,238	59,131	21,539	168	328	5
Raw	195,590	128,242	172,659	95	47	160
Molasses	21,133	11,691	14,353	171	427	7
	342,96	199,064	208,551	434	802	172

	HOME CONSUMPTION.		
	1915. Tons.	1916. Tons.	1917. Tons.
Refined	82,495	89,906	28,429
Refined (in Bond) in the United Kingdom	135,629	109,397	100,901
Raw	45,476	21,548	48,592
Molasses	25,922	12,294	15,578
Molasses, manufactured (in Bond) in United Kingdom	10,697	10,578	10,164
Total	300,219	243,723	203,664
Less Exports of British Refined	882	1,888	273
	299,337	241,835	203,391

THE
INTERNATIONAL
SUGAR JOURNAL.

No. 220. APRIL, 1917. Vol. XIX.

☞ **All communications to be addressed to "The International Sugar Journal," 2, St. Dunstan's Hill, London, E.C.**

Cheques and Postal Orders to be made payable to "The INTERNATIONAL SUGAR JOURNAL," and not to individuals

☞ **The Editors are not responsible for statements or opinions contained in articles which are signed, or the source of which is named.**

The Editors will be glad to consider any MSS. sent to them for insertion in this Journal and will endeavour to return the same if unsuitable; but they cannot undertake to be responsible for them unless a stamped addressed envelope is enclosed.

Notes and Comments.

Beet Sugar Production in the United Kingdom.

We are glad to chronicle the attainment of what must be considered an important stage in the process of inaugurating on a real scale a beet sugar industry in this country. An official committee appointed by the late Government last August to go into the question of our after-war agricultural policy has just issued its preliminary report, and in it we find them warmly advocating the establishment of a beet sugar industry in our midst, not only as a means of producing at home a considerable proportion of the sugar we consume, but also because the committee believe that the introduction of the beet crop into our rotation will increase the yield of other crops. In short, they agree that such an industry will be a contribution of much importance to the increased production of food stuffs in the United Kingdom. Accordingly, they urge the Government to arrange without further delay for a *complete test* of the commercial possibilities of manufacturing sugar from home-grown beets.

As a well-considered statement on the part of an official body of the value of such an industry in our midst this pronouncement is most opportune and welcome. It concedes nearly all that the most expert advocates of the scheme have advanced. The only doubt left in the minds of the committee is as to whether the industry can be maintained on a profitable basis, for they express the opinion that no experiment on an adequate scale has yet been made to establish this fact. That is undoubtedly the case, for owing to the lukewarmness of previous Governments it has never as yet been possible to prove from practice what a well-equipped beet sugar usine in this country, fed with an adequate and continuous supply of roots, can do in comparison with other beetroot sugar industries of the world. But it has been held with good grounds by the vast majority of those who have investigated the question that there is no reason why, with a reasonable measure of preference for an infant industry, it should not be firmly established in the end and be able to compete with other sources of supply. Elsewhere we publish a long letter from Mr. H. F. EASTON, a keen advocate of this branch of agriculture, who is Consulting Technical Adviser to the British Beet Growers' Society, and has been closely connected with the Cantley factory in Norfolk. He endeavours to show what the industry might expect to do at the start and what the maximum cost of the sugar so produced might amount to. He compares his figures with those of a model German factory, which were given in our pages some years ago[1], and allowing for higher remuneration to the farmer for his roots, he claims that the costs to be expected at the outset are sufficiently moderate to warrant success if only reasonable protection is guaranteed the industry for a period of years. In view of what the Government are now proposing to do for other branches of British agriculture to ensure stability of remunerative prices for the farmers, which can only be done by ensuring them preference over foreign produce, it is hardly likely that the one thing needful in our own case should be treated as impractical politics.

As the Government have been giving State aid and State supervision in so many directions during the past two years where the necessities of the country made it urgent, they might well add one more to their responsibilities and make the "complete test" themselves. Let them plan and erect in the most favourable situation available a beet usine on a sufficiently large scale, put in charge of men who have no patent axes to grind and who have only one incentive—to employ the best tried methods, let them teach the surrounding farmers the value of a beet crop not only for itself but as a means of improving other crops; then when the factory has got on its legs and proved its practicability, let them sell it as a going concern to a co-operative body which shall consist primarily of the growers themselves and not of outside capitalists. Then we shall have had the best conditions for a complete test, and if it fails, even with fiscal preference to aid it, it will be time enough to consider sorrowfully that British agriculture must dispense with one of the most valuable adjuncts which its sister industries on the Continent and elsewhere possess. But we are confident it will not fail if the management is sound.

Food Control.

The Food Controller (LORD DEVONPORT) has been busily engaged the past few weeks in dealing with the restricted supply of food. The voluntary system is still in force and will be continued as long as possible; but plans are being completed for some form of rationing if that should be found necessary in the end. It is however scarcely possible to ration in respect of food which is partly or wholly produced at home, as it is not practicable to prevent the producer living on his own produce (*e.g.*, in the matter of eggs, butter, poultry, milk, etc.). But the principal shortage is evidently that of bread-making material, and it will probably be here that a trial of rationing will first make itself inevitable. Still it is not a task to be lightly undertaken; it has been estimated that if six articles of food were to be rationed and each family were given twelve tickets a week to buy these things twice a week, it would need 120,000,000 tickets a week, the production of which alone would involve an enormous waste of paper and labour, while the distribution of the tickets would demand an army of officials taken away from other important war work. No wonder, then, the authorities will try any other method than that one as long as possible.

---

[1] *I S.J.*, 1910, 166.

Next in importance to bread comes sugar. There has been enough sugar coming into the country just lately to provide, apart from the needs of the professional sugar users, a ration of ¾lb. per head per week, but owing to serious leakages due largely to excessive buying and hoarding on the part of a selfish section of the community there is considerable scarcity in various centres of distribution. Moreover during April it is understood that supplies of sugar coming in will be further restricted till the new Cuban crop commences to arrive, and it is possible that the ¾lb. ration may have to be reduced by one-third, for a time at any rate. Since Lord Devonport has been at the head of the sugar Commission he has evidently not been satisfied with the way the available sugar has been distributed, for he has appointed a small committee of enquiry to overhaul the system at present adopted by the Commission and to report what further steps should be taken to arrange the allocation of existing supplies. This committee is expected to report in the course of a week or two.

In addition, an Order against hoarding of supplies is in preparation and has been expected any day for the past fortnight. It appears that the intentions in this respect were prematurely revealed in the press and the country learnt that it was contemplated to forbid the storing of more than a fortnight's food by any household, and to penalize any tradesman who knowingly sold more than that proportion to any customer. It was also proposed that the police should have the right of entry to a house to search for hidden stores. Possibly the premature announcement was not without its uses, as many drawbacks and inequalities were promptly pointed out; and probably in consequence the actual issue of the Order has been delayed for further consideration of its clauses.

It has however been stated officially that there is no intention of penalizing those who save from their ration in order to have sugar for preserving fruit in the coming summer; whether any extra allowance will be made to the public, when the time arrives, for this widespread domestic custom must depend on whether the imports of sugar are then more liberal, but the official attitude in the matter is now apparently more sympathetic than it was a few months ago.

Further reductions in their sugar allowance have however been inflicted on the confectioners. In January their sugar issue was cut down to 50 per cent., and this has since been further diminished to 40 per cent. Greater restrictions are for the present impracticable, if only for the reason that fighting men are declared to have an astonishing appetite for sweets, and indeed the greatest demand on the manufacturing confectioners is said to be for export to the troops.

The Cuban Revolution.

After all, the early promise of a record Cuban sugar crop of 3,500,000 tons is not to be, on account of the unfortunate outbreak of revolution in the island which has paralysed work since the beginning of February. The inability of the two chief political parties in Cuba to come to an understanding as to the government of the island has apparently led the extremer elements of the party out of power to start an insurrection under the leadership, it is alleged, of General Gomez, the former president. Unfortunately, there are large sections of the native Cuban population which seize the opportunity that a revolution gives them to satisfy their natural inclinations to loot and destroy property. Consequently, although the reports so far to hand are rather conflicting, it is undoubtedly the case that a considerable amount of damage to sugar properties has been done, canefields, if not factories, having been fired, while railroads have been paralysed by having their bridges destroyed, so that many factories which have escaped the immediate effects of the revolutionary depredations have nevertheless had their work brought to a standstill for lack of inward supplies, or through scarcity of labour, the usual hands having joined the revolutionaries.

One authority puts the amount of cane burned in the fields at over 500,000 tons; but this is only a conservative estimate as news is difficult to obtain, and the Eastern Provinces are still very much at the mercy of the lawless bands of insurgents who having once received instructions from their leaders to try and close down the mills as a means of bringing the Government to terms are less easily stopped in their depredations by any subsequent rescinding orders. Besides the Eastern Provinces, the Central ones, and even that of Havana, have had to cope with threatened burnings of fields.

The latest reports would, however, appear to justify the belief that the worst of the trouble is now over, and that there is a desire on the part of the responsible revolutionists to stop military action against the Menocal Government under the promise of the United States authorities to superintend a fair re-election in the Oriente Province. The Cuban Government indeed state that every mill in the island is now grinding, and they allege that reports of damage to property and fields have been greatly exaggerated; this last may indeed prove to be the case, but private advices seem to be unanimous in regarding it as serious enough.

As a result, the estimates of the Cuban cane crop have had to be radically revised. GUMA and MEJER consider that the crops will come to less than three million tons. Messrs. HIMELY and Messrs. WILLETT and GRAY incline to the three million ton mark, while other observers place it lower, at 2,800,000 tons at most. It is clear in any event that the crop will be much reduced, and in view of the decreased demand for sugar owing to the lack of shipping facilities, the shortage, whatever it is, will help to steady prices.

Cuba's Soil.

We have on more than one occasion taken the opportunity to question the wisdom of the methods adopted in Cuba of working the virgin soil to more or less exhaustion without any regard to the needs of a future generation of tillers. We notice with approval that *Modern Cuba* has lately had some pertinent observations to make on the same subject. Our contemporary wrote: "As long as great areas of virgin forest remain untouched Cuba can easily maintain her position as the greatest and cheapest sugar producer, without material change in existing methods. In the older sugar districts, which to-day contain a larger share of the capital invested in this business, forest lands no longer exist. Here all these basic agricultural problems must be faced and solved if the next period of low prices, sure sooner or later to follow the present war inflation, is not to be followed by the disastrous collapse of many heavy investments. It only takes a hasty trip through Camaguey and Oriente to show with what feverish rapidity Cuba's remaining forests are being cut down and planted to cane. At the present rate, less than a generation will see the end of them. The entire island must then settle down to a study of cane agriculture. The importance of its problems is, therefore, sufficiently great to make it the duty not only of the mill owner and colonial, but of every person in any way connected with the sugar industry to give them most thoughtful consideration."

Canada and the West Indies.

A recent article in the *Times* by a Canadian contributor made an admittedly reasoned plea for a political union between Canada and the British West Indies, on the grounds that the interchange of trade between the two would be greatly strengthened and the island colonies would be able to find a market for their products on advantageous terms without fearing the consequences of losing the United States market. It was in fact such a fear in respect to the exports of bananas to the States which made Jamaica some years ago refuse an offer of preferential trade with Canada lest the United States should retaliate. But it would be immaterial what action the latter took if a market for the whole of the West Indian output were assured in the Dominion through political union.

As the *West India Committee Circular* remarks, this suggested union is no new proposal, and is one with regard to which it is very desirable to keep an open mind; it is one of those difficult questions which should be reserved for consideration till we have emerged from the present war, when our whole Imperial policy will come under revision. Our own view is that no decision should be come to for a decade at least after the war, when time will have been allowed for the mother-country herself to show what she can do to foster preferential trade relations with her Crown colonies. Then when, with all the new spirit of goodwill that has lately grown up in our midst, it can be shown that we are not satisfying the legitimate needs of the colonists for an active commercial union, it will be surely time enough to let Canada step in and absorb the islands within her dominion. Apart from commercial relations, these islands have an increasing value as naval centres, and it will hardly be gainsaid that, for that purpose, the retention of the colonies under the Home Government would be considered a prime necessity.

Apropos of naval values, it is interesting to note that according to the writer in the *Times* above referred to, it was owing to the fact that German capital was so largely interested in the commercial development of the late Danish West Indies that America found it so difficult to buy them. But for their recent purchase by the States, Germany would have obtained political control of them, and would eventually have annexed them, in which event she would assuredly have turned them into a second Gibraltar, wherefrom to paralyse the Panama sea route with her underwater craft.

Excess Profit Duties on Sugar Estates.

Our reference last month to sundry sugar company dividends served to show how restricted some of the ones declared by British companies have been in view of the working of the excess profits tax, one of the principal war-time resources of the Treasury, which provides that one-half of all profits over £200 in excess of those made before the war shall be payable to the Treasury. To arrive at the pre-war rate of profit, one could either take the average of two out of three years before the war or else adopt a percentage standard, which was fixed by the Government at 6 per cent. for companies and 7 per cent. for individuals. This stipulation has indeed promised to affect so seriously sugar producers whose businesses were domiciled within the United Kingdom that representations were made to the Treasury by the West India Committee and the West India Associations of Glasgow and Liverpool for an increase in the percentage standard to be allowed in the case of the West Indian sugar industry. In support of this claim the various economic vicissitudes to which the sugar industry has been subject were advanced, and the risks to which agriculture in the tropics is liable were reviewed. As a result, the Commissioners of Revenue referred the matter to the Board of Referees, who decided to raise the percentage standard from 6 to 11 per cent. in the case of companies and from 7 to 12 per cent. in the case of individuals. This means a considerable improvement in the profits that may be retained, and while it is not perhaps as high as proprietors of sugar estates might have wished for in view of the meagre returns which were a feature of the years before the war, it is a concession that will leave them much less hampered for funds for future expansion than the original percentage would have done.

As an American contemporary[1] puts it, the Board of Referees has by its action endorsed the claim that a sugar enterprise should be allowed to earn something more than what is regarded as a fair return for an ordinary business undertaking, when it can, because there are many seasons when it cannot realize a profitable return. This decision in fact is of particular interest to American sugar producers just now, for the United States has copied this country in instituting a tax on profits, and it would seem that the question as to whether this new tax applies to sugar production or not is still undecided, while there is room for a difference of opinion on the point.

Rind Disease of Sugar Cane.

A further contribution to the literature dealing with the history and cause of the rind disease of the sugar cane (*Melanconium sacchari*) has lately been compiled by Mr. J. R. JOHNSTON, formerly Pathologist of the Insular Experiment Station, Rio Piedras, Porto Rico, and is published in the first number of the newly-started "Journal of the Board of Commissioners of Agriculture," Porto Rico. Mr. JOHNSTON's plea for another contribution to the subject is that owing chiefly to inaccurate and incomplete observations, existing literature is almost hopelessly confused as to the real nature of the fungus or the disease caused by it. He has for the past three years made a careful study of this literature in the light, we gather, of numerous field and laboratory investigations, and has come to the conclusion that the rind disease causes a great loss in many canefields, in Porto Rico amongst other places. His present paper gives the history and identity of the rind fungus, and summarizes the discoveries of Cooke, Went, Massee, Howard, and others. He also deals with the geographical distribution of the disease, giving a useful enumeration of the countries where it has been located.

Summarizing, he states that the disease has been studied for 20 years at least in various parts of the world; the fungus has only one known spore form in its life history ; it is a wound parasite and attacks specially certain weak or soft canes such as Bourbon and D.116; so far treatment of the disease has been restricted to the use of hardy varieties, to adopting such methods as will reduce the moth borer, and to grinding the cane before it is overripe The paper concludes with a useful bibliography of 39 references to the subject.

The New Year's Honours List brought the well deserved bestowal of a knighthood of the Order of St. Michael and St. George on the Hon. FRANCIS WATTS, D.Sc., Imperial Commissioner of Agriculture for the West Indies.

Following on the decision of the United States Congress on April 4th to declare war on Germany, the Cuban Government has taken a like step. That Cuba should have troubled to resort to such a proceeding suggests that there must have been some clear evidence extant that Germany through her agents had had a hand in the recent disturbances in that island.

Another instance of the desire of Mr. Lloyd George's Government to fill official posts dealing with trade or industry with men who have expert knowledge of the subject is shown by the appointment of Mr. A. D. HALL, the well known agricultural expert, to be Permanent Secretary of the Board of Agriculture. The choice could not have fallen on a better man.

---

[1] *Facts about Sugar.*

Beet Sugar Production in the United Kingdom.

Recommendations of a Government Agricultural Committee of Investigation.

In August last the late Government appointed a Reconstruction Committee, empowered to go into the question of after-war questions of industry and economics. Out of this a Sub-Committee was formed to cover agricultural policy; its work was to consider and report upon the methods of effecting an increase in the home-grown food supplies of the United Kingdom, having regard to the need of such increase in the interests of national security.

This body was a strong one and well representative of agriculture, including as it did LORD SELBORNE (in the chair), Captain BATHURST, M.P. (the present Parliamentary Secretary for the Food Controller), Mr. A. D. HALL, the well-known agricultural expert (who is now Permanent Secretary of the Board of Agriculture); Mr. R. E. PROTHERO (now President of the same Board); the Hon. E. G. STRUTT, a leading agriculturist; and Sir MATTHEW WALLACE, ex-President of the Scottish Chamber of Agriculture. The first part of their Report has now been issued (*Cd. 8506*) and is instructive reading. It touches on the effects of agricultural depression, the prices of cereals, the need for a new agricultural policy, the question of agricultural wages (which have long been a crying scandal, and are to be raised by the present Government to a minimum of 25s. per week), methods of securing increased production, and finally, and what is of most interest to us, the question of sugar beet growing and beet sugar production. Below will be found the conclusions come to by the Sub-Committee on this last important question.

SUGAR BEET.

Before concluding this part of our Report, we wish to make certain recommendations in respect of the introduction of the sugar beet industry into the United Kingdom. For several years the possibility of developing the agricultural resources of this conntry by introducing the sugar beet industry into England and Wales has been under consideration by agriculturists and the Government Departments concerned. We believe that the advantages to be derived from its successful establishment would be very important. The nation, by producing a proportion of its own requirements of sugar, would reduce its dependence on imported supplies from Germany and Austria, from which countries, in the three years before the War, 1911-13, we received 53 per cent. of our total imports of sugar. The rural community would be benefited and augmented by the provision of employment in sugar factories in the winter months and of additional work on the land in the summer. Agriculture would gain by the introduction of a new crop, which yields a satisfactory cash return to the farmer and leaves a residue which is a valuable cattle food. Moreover, wherever beet was grown, the deep tillage and improved cultivation necessary for its success would prove of immense benefit to the other crops in the rotation as well as an object lesson to the country in good farming. Of all these statements there is abundant evidence from Continental sources (*e.g.*, "The Recent Development of German Agriculture" [1]).

Before the beet industry can become the object of private enterprise, it would be necessary to ascertain by experiment an answer to two questions, namely: Can sugar beet be grown successfully in this country? and, secondly, Can sugar be manufactured from home-grown beet at a profit after paying an adequate price to the grower? The first of these questions has for some years passed beyond the experimental stage. Many trials in cultivation have been made, and it is generally agreed that sugar beet can be grown successfully in many districts of England and Wales. The Board of Agriculture and Fisheries, for example, in reporting[1] on experiments arranged in 1911 at seven centres in England, stated: "There is no question that beet with a high sugar content can be grown in this country and give yields equalling, if not exceeding, those obtained on the Continent."

---

[1] Cd. 8305, p. 38. See *I.S.J.*, 1916, 354

Since that date various efforts have been made with a view to testing the possibility of manufacturing sugar in this country at a profit, and we wish specially to mention the beet sugar factory which is in actual existence at Cantley in Norfolk. British agriculturists owe a debt of gratitude to the men who have borne the burthen of the pioneer work done at Cantley, and a tribute of admiration for the pluck with which they met unforeseen difficulties caused by the War, until the refusal of the Dutch Government to allow the export of seed brought their operations to a temporary conclusion. Nevertheless, we do not think that an experiment on an adequate scale has yet been made. Up to the present the Government has been hampered in providing financial assistance towards the erection of a sugar beet factory (or in guaranteeing a company against loss) by two considerations In the first place, the Brussels Sugar Convention limited the extent to which Government assistance could be given to the industry by pledging adhering States not to give bounties on the export of sugar, which the Board of Trade considered included the payment of grants to assist the manufacture of home-grown sugar, of which some might be exported. His Majesty's Government withdrew from the Brussels Sugar Convention as from 1st September, 1913. Although, at that time, they expressed continued adherence to the fundamental principles of the Convention, they reserved to themselves power, by giving six months' notice, to adopt any measures they thought fit to promote the establishment of the sugar beet industry. The second difficulty has been the limitation imposed on the Development Commissioners by the Development and Road Improvement Funds Act, 1909, to recommend advances only to associations not trading for profit Probably one of the best ways in which the required experiment could be carried out under commercial conditions would be for the Government to undertake to share (or to guarantee) any loss, up to a specified amount, which might be sustained by a company aiming at making a profit for its shareholders Such a scheme cannot at present, however, be aided from the Development Fund. To surmount this obstacle we recommend that either the Development and Road Improvement Funds Act should be amended in this respect, or that the Government should provide the necessary assistance from sources not subject to the same restrictions as the Development Fund.

A Society, entitled the British Sugar Beet Growers' Society, Limited, has recently applied to the Treasury for a grant from the Development Fund to enable it to purchase an estate of about 5,000 acres with a view to the erection of a factory and the cultivation on its own land of a sufficient acreage of beet to produce the minimum amount of roots required to work the factory economically. Captain BEVILLE STANIER, M.P., the Chairman of the Society, in his evidence before us, stated that the capital required to purchase the estate, erect and equip the factory, &c., would be £500,000, of which he hoped that the Government would agree to contribute one-half, to be repaid, if required, at the end of ten years, during which period the State would be asked to guarantee interest on the remaining capital raised from private individuals. The State would also be asked to undertake to continue during the initial period of ten years the present surtax, that is the difference between the Customs duty on imported sugar and the Excise duty on home-grown sugar, which at the present time amounts to 2s. 4d. per cwt. We believe this scheme to have been thought out with great care and to be a sound one, but as it is now under the consideration of the Government we do not express any opinion upon its details. We desire, however, to place on record our opinion that before the industry can be established it is necessary to ascertain (*a*) the price which a factory could afford to give for roots; (*b*) whether that price will be sufficient to induce the farmer to substitute beet for a portion of his present root crop, and (c) how far beet growing can be introduced into the systems of farming at present carried on in this country. These questions can only be settled by an experiment on a commercial scale, but we are of opinion that the best method of conducting such an experiment will be by the institution of a large farm under the same control as the factory.

---

[1] Cd. 6162, 1912, p. 14.

In view of the great importance which we attach to the establishment of the beet industry, we urge the Government to arrange without further delay for a complete test of the commercial possibilities of manufacturing sugar from home-grown beet. We hope that this test will prove that a considerable proportion of the sugar we consume can be grown in the United Kingdom, and that the introduction of the beet crop into the rotation will increase the yield of the other crops. In short, we believe that it will prove that the introduction of the sugar-beet industry will be a contribution of much importance to the increased production of foodstuffs in the United Kingdom.

A Minority Report was however submitted by Sir MATTHEW WALLACE, in the course of which he made the following remarks.

"I have no personal experience of the cultivation of sugar-beet, but after a careful consideration of the evidence I support the recommendation of the Report. Unquestionably, if a root crop of such importance could be established as an economic proposition it would go far to solve the problem of increased tillage. Root crops, or, as they are called in some districts, fallow crops or green crops, are, in my opinion, the foundation of tillage operations and are in the true sense the pivotal crops. Secure these, and cereal crops automatically follow. This is, of course, diametrically opposed to the opinion expressed in the Report that cereals are to be the pivotal crops. I regard this difference as one of extreme importance and it governs to a great extent the different opinions expressed. In this opinion I am supported by Dr. RUSSELL, of Rothamsted, who says in his evidence 'the key to the situation seemed therefore to lie in the root or fallow break. The wheat crop may be regarded as the superstructure seen by the public but the root crop was the foundation on which it rested.'

"The fact that on the one hand this country with its teeming population affords an unsurpassed market for agricultural produce, while on the other, the land of these islands provides soil of almost unrivalled productivity, should surely lead to the reflection that some intervening obstacle must be responsible for any failure on the part of agriculture as a profitable industry."

The British Empire Producers Organization.

The policy of this energetic and, so far, successful association is evidently bearing fruit already. They have given many public dinners or lunches at which over-seas ministers have had the opportunity of speaking out freely on the pressing subject of our Imperial economic policy after the war. At the outset of the Association's career, they gained, as our readers will recollect, the eloquent support of Mr. HUGHES, the Australian Premier. Now they are striking out in a fresh direction. At their special request a short history of sugar during the last 60 years has been written by Mr. GEORGE MARTINEAU, C.B., our leading authority on sugar economics, and they have brought the warning contained in that striking narrative to the personal notice of the press by giving a dinner at which the London and provincial press were well represented. One of the editors present gave, in the *Morning Post*, of March 19th last, the following account of the proceedings:—

"Several prominent members of the British Empire Producers' Association invited a number of guests to a dinner at the Savoy Hotel in order to hear and discuss Mr. GEORGE MARTINEAU'S brief history of the British sugar industry and the injuries inflicted on it by the Continental Bounty system. The Martineau family have been connected with the sugar industry for several generations—their refinery having been established in Whitechapel in 1790—and Mr. GEORGE MARTINEAU, who is in his eighty-third year, was prominently associated with the British opposition to the Continental Bounty system. Extracts from his admirable book, which is shortly to be published, were read by his son, and they made a very interesting summary of the destruction of a great British industry by the German system of protecting beet sugar. A noteworthy point made was a description of how the United States by a small protective duty, which only amounted to half a farthing a lb., had cheapened sugar to the consumer, and, by largely increasing production, had saved England and the world from a sugar famine during this war.

"Mr. W. F. MASSEY, Prime Minister of New Zealand, in the course of a short speech, said that, although originally he called himself a Free Trader, he now considered that some great change in our economic system was absolutely necessary to pay for the war, and that the war could only be paid for by developing the magnificent resources of the British Empire.

"Sir JOSEPH WARD, Finance Minister of New Zealand, also laid emphasis on the need for a new fiscal system for the British Empire and the development of its resources.

"Mr. C. SANDBACH PARKER, who was in the chair. pointed out that a duty of half a farthing a pound, which had sufficed for the United States, would not be sufficient in this country, because we were up against a strongly-organized and well-established industry, whereas our own would have to be built up again. The interest of the British consumer would be best served by taking effective measures to re-establish the sugar industry within, the Empire; the supply being increased, the consumer would benefit.

"After the main speeches there was a discussion, in which many points of interest both to sugar producers and consumers, were brought up."

Mr. MARTINEAU's book (which we propose to review in an early number) has evidently had a good send-off, and we hope the results of its perusal will soon be reflected in a more accurate and intelligent handling of the sugar question in the leading articles of our general press than has hitherto been the rule.

The Cuba Cane Sugar Corporation has wisely established an agricultural experiment station at Central Mercedes, Cuba, with the object of studying sugar cane problems, such as the breeding of new varieties, fertilizing, irrigation, etc., and has appointed as its first Director, Mr. MARIO CALVINO, Doctor of Agricultural Sciences from the University of Pisa, Italy, who has been for the past seven years with the Department of Agriculture of the Mexican Republic.

The advantage of sugar estate owners running their own steamers is shown by the fact that the United Fruit Co., of Boston, a shipping company who own the Banes and Nipe Bay centrals in Cuba, are turning out sugar this season at less than 2·1 cents per lb., freight and insurance included. This is based on a freight rate of 25 cents per 100 lbs., but many less fortunately placed sugar producers are paying a rate of 50 to 55 cents.

Prof. BUSSANO's remarkable experiments on the antiseptic, absorbent and cleansing properties of sugar, particularly glucose, in veterinary operations are confirmed by P. BIMBI,[1] who further finds it also possesses the property of promoting the formation both of the soft and horny tissue of the foot of the horse, its value for this latter purpose excelling all substances in common use, as carbolic oil, naphthalin, and Socin's powder and paste.

---

[1] *Il Moderno Zooiatro*, **5**, 109-115.

The Extraction of Sugar from Final Molasses.

By H. C. PRINSEN GEERLIGS, Ph.D.

With considerable astonishment I have read in several sugar papers (among which is included the *International Sugar Journal*[1]) of a new scheme, advocated by Mr. J. N. S. WILLIAMS, intended to extract sugar from final molasses—one not working on a new basis, but only by the application of evaporation, cooling and curing in practically the same manner as is usually done.

According to the article referred to, it is not the glucose, gums or ash in the molasses, which either singly or in combination prevent the sucrose therein from crystallizing, *but solely the water present;* and as one part of the water will hold in solution two parts of sucrose, it seems clear that a molasses containing any considerable percentage of water cannot be made to yield up its sucrose in any other manner than by removing the water, and thereby allowing the sucrose to crystallize out.

One reads further that it is a correct statement to say that the sucrose in all final molasses produced in the territory will crystallize out in a grain that is visible to the unaided eye if the molasses be evaporated to a density of say 99° Brix at ordinary temperature.

I was very much struck by these statements, which, if true, tend to overthrow entirely all molasses-theories established for some decades past. All work devoted to the study of the formation of molasses made by numerous scientists and practical men for scores of years both in the province of beet and of cane sugar would be rendered void, if really one had only to evaporate one's final molasses to a density of 99° Brix to see all the sucrose crystallize out in a condition which allows of its being extracted by centrifugalling.

Yet a certain doubt remained in my mind when reading the article, whether actually all the sucrose would really crystallize out, and that doubt was based on the figure given of the quantity of sucrose or commercial sugar which would be the result. Mr. WILLIAMS mentions a gain of 3½ per cent. of the present quantity of sugar produced in the Hawaiian Islands, but if all of the molasses had its total sucrose content crystallized out, the gain would be much greater.

According to the synopsis of results obtained in a great number of sugar factories in the Hawaiian Islands, communicated in the Bulletins of the Honolulu Experiment Station, the average loss of sucrose in molasses on 100 parts of cane was 0·99 in 1914 and 0·97 in 1915, while the sugar produced on 100 parts of cane was respectively 12·39 and 12·52 per cent. The total amount of sucrose lost in molasses, calculated on 100 parts of sugar delivered, is therefore 8·3 per cent. for 1914 and 8 per cent. for 1915, so that the increase in the production would at any rate have been much more than the figure of 3½ per cent. given, if the total amount of sucrose in the molasses really crystallizes out by mere evaporation and cooling.

However, the further perusal of the data given in the reports shows that it is not at all the total amount of sucrose which crystallizes out of the final molasses, but only that portion that is dissolved in the so-called "molasses," which is present there in excess of the sucrose which really belongs to the real molasses and cannot crystallize out because of its being combined with the salts, the glucose and other matter. The figures show that when a "final" molasses of 40° purity was evaporated, cooled and centrifugalled, it was separated into molasses and a magma of fine sugar crystals and molasses having a polarization of 50 per cent. and a purity of 53°.

---

[1] 1917, 90.

Another portion of so-called "final molasses" having an apparent purity of 35° yielded a magma having a polarization as high as 58 and a purity as high as 64° with a waste molasses having a polarization as low as 22·5 and a purity of 27·73°.

The average of a large number of records of results from solidified molasses having a purity of 35° after treating and separating, is: magma, 45 per cent.; sucrose, 50 per cent.; purity, 50°; and a waste molasses of 27 per cent. sucrose, and 30° purity.

The memorandum read by Mr. Williams contains the quantities, and we find that after boiling a No. 1 molasses of 47·41° purity, 644 lbs. of solid molasses of that same purity were obtained. This quantity was made fluid with 7 per cent. or 47 lbs. of water, producing a massecuite which weighed 691 lbs. This was spun in a high-speed centrifugal in four charges, producing a magma which weighed 364·5 lbs., being 52·7 per cent. of the charge as introduced in the centrifugal. The recovered magma polarized 57 per cent. sucrose and had a purity of 59·9°. The molasses removed during the operation had the following analysis: Weight, 326·5 lbs., being 47·3 per cent. of the charge introduced into the centrifugal; Brix, 88·76 per cent. solids; polarization, 25·63 per cent.; and purity, 28·87°.

From these figures we see that the alleged invention is nothing more than a common exhaustion of molasses to an ordinary final molasses, based on commonly used principles, and that in a rather irrational way. It is not an extraction of sucrose from a real waste molasses at all, but rather a formation of waste molasses from molasses which contains still more sugar than it might do if properly worked out. Notwithstanding Mr. Williams' assertion that it is not the glucose, the gums or the ash from the molasses which prevent the crystallization of sucrose from it, but only the water content, he ends with a final molasses, after all the water had been eliminated, having a purity of something under 30°, which is the common value for every properly-treated final or waste molasses in modern sugar-houses.

If a molasses of 47° purity or 35° or thereabouts is for convenience' sake called a final molasses, it is possible to extract still some sugar from it by evaporation, cooling and curing, but that cannot be understood from the words "sugar extraction from *final* molasses," which process in reality could not take place by such simple means.

When applying the usual rendement formula[1] on the figures given by Mr. Williams, we find the percentage of the magma of 59·9° purity, which is supposed to be in a dry state, from 100 parts of the dry molasses of 47·41° purity to be as follows:—

$$\frac{47{\cdot}41-28{\cdot}87}{59{\cdot}9-28{\cdot}87} \times 100 = 59{\cdot}8$$

or, on the 644 lbs. of evaporated molasses $\frac{644}{100} \times 59{\cdot}8 = 385$ lbs., while during the experiment 364·5 lbs., or slightly less, were obtained.

Hence we see that nothing more has occurred than that a rather rich molasses has been boiled string-proof and, after cooling, has been diluted with water and separated in a centrifugal into a very low grade after-product and waste molasses. This low grade after-product was too bad to be sold; it was dissolved in water, boiled string-proof again, cooled and cured. The result was an after-product which could find purchasers and a molasses, of which no particulars have been made known. Assuming the purity of that molasses to be also 28·27, the total yield of sugar of 96° polarization, or 97° purity and 0·5 per cent. of moisture from 100 parts of dry molasses of 47·71 would have been

---

[1] See e g. H. C. Prinsen Geerligs, "Practical White Sugar Manufacture," p. 108.

$$\frac{47{\cdot}71 - 28{\cdot}87}{97 - 28{\cdot}87} \times \frac{100}{99{\cdot}5} = 27{\cdot}9$$

If starting from the average Hawaiian figures, published in the synopsis for 1915, we assume a percentage of sucrose extracted in juice of 13·26 in a purity of 84·75° and imagine these juices to be worked down to a molasses of 47·71° purity and also to one of 28·87°, the yields of sugar of 96° polarization and 0·5 per cent. of moisture would have been on 100 cane

$$\frac{84{\cdot}75 - 47\ 41}{97 - 47{\cdot}41} \times \frac{100}{84{\cdot}75} \times \frac{100}{99{\cdot}5} \times \frac{13{\cdot}26}{100} = 11{\cdot}84$$

and

$$\frac{84{\cdot}75 - 28{\cdot}87}{97 - 28{\cdot}87} \times \frac{100}{84{\cdot}75} \times \frac{100}{99{\cdot}5} \times \frac{13{\cdot}26}{100} = 12{\cdot}89$$

or an increase of about 9 per cent.

This, however, is a special case, as in very few instances will a molasses of 47·41 purity be considered as exhausted or waste; but if we start from the average figure for the purity of the final molasses in the Hawaiian Islands of 40°, as recorded in the synopsis of 1915, we obtain these figures:—

$$\frac{84{\cdot}75 - 40}{97 - 40} \times \frac{100}{84{\cdot}75} \times \frac{100}{99{\cdot}5} \times \frac{13{\cdot}26}{100} = 12{\cdot}34$$

and

$$\frac{84{\cdot}75 - 28{\cdot}87}{97 - 28{\cdot}87} \times \frac{100}{84{\cdot}75} \times \frac{100}{99{\cdot}5} \times \frac{13{\cdot}26}{100} = 12{\cdot}89$$

which means an increase in yield of 4·4 per cent.

It results from these calculations that the increase in yield promised by Mr. Williams can really be obtained, but it is not owing to any new method based on principles which overthrow our well-established theories on molasses-formation, but only due to the fact that such sugar was previously left in the molasses; and that many samples of molasses were already considered as "final" ones which could still give up more of their sucrose content by rational treatment.

We cannot say that we approve of the method by which Mr. Williams is exhausting his molasses. It is neither cheap nor rational. It involves two boilings to string-proof, a dilution of the first boiling, and breaking the massecuite in a pug-mill and curing twice, while one of the curings has to be done in a special high-speed machine.

I have indicated in my books[1] much better methods, by which the string-proof boiling has been done away with entirely and by which the molasses is boiled in the vacuum pan on a *pied-de-cuite* of crystals till a mixed massecuite of 60° purity and 98° Brix results. When this is cooled in motion for three days and centrifugalled in common Weston centrifugals, it is separated into an after-product sugar and a final molasses of about 30° purity.

The schemes on pages 105-108 of my work on "White Sugar Manufacture" clearly show how this may be done and, following these, one may be certain of having an exhausted molasses five days after the cane serving as raw material has been crushed, and that without special machinery, and without extra work or trouble.

---

[1] H. C. Prinsen Geerligs, "Cane Sugar and its Manufacture", also "Practical White Sugar Manufacture."

Studies in Cane Sugar Manufacture.

INVESTIGATIONS ON PROCESSES IN WHICH THE TOTAL CLARIFIED JUICE IS PASSED THROUGH FILTER-PRESSES

By CHARLES FRIBOURG

II.

ANALYSES OF DICALCIUM PHOSPHATE.

Theoretically dicalcium phosphate has the formula $CaHPO_4\ 2\ H_2O$, corresponding to the following percentage composition :—

Phosphoric acid (P_2O_5)	41·28
Lime (2 CaO)	32·56
Water (5 H_2O)	26·16

The pure phosphate which we used for our experiments gave the following analysis:—

Phosphoric acid (P_2O_5)		41·24
Soluble in water	None	
Soluble in citrate .. .	41·24	
Lime (2 CaO)		32·93
Water (5 H_2O)		25·84

Thus, its composition was very close to the theoretical one. Here, moreover, are some analyses of commercial dicalcium phosphates which we have had occasion to employ :—

	A	B
Water	2 00	—
Alkalis . .	—	0 61
Iron (Fe_2O_3)	—	0·17
Monocalcium phosphate	2·50	1·43
Dicalcium phosphate . ..	83·00	84 06
Tricalcium phosphate . .	12·50	11·78

Consequently, these products contain a very high proportion of dicalcium phosphate; but, generally, are insufficiently fine. In order to be used for the purpose in view, it is necessary that they should possess the greatest possible degree of fineness, which is precisely the case with Mr. Guerrero's "Phosphogelose."

ANALYSES OF VARIETIES OF KIESELGUHRS.

We have before us several varieties of kieselguhr, and must say that all do not respond to the desideratum necessary.

A good kieselguhr must be excessively light, and should contain 90 to 95 per cent. of silica (after deducting water). The tint is generally characteristic—slightly reddish. On the other hand, a rather dense whitish kieselguhr gave these figures on analysis :—

	Per cent.
Water	11·10
Silica and silicates	45·69
Carbonic acid	16 00
Sulphuric acid	0·45
Phosphoric acid	trace
Alumina	1·67
Ferric oxide	1·02
Lime	19·40
Undetermined	4·67

This product contained 36·0 per cent. of calcium carbonate, and consequently was unsuitable for the special work for which it was required.

It is therefore very important in employing kieselguhr in the sugar factory to first verify its composition, and to make a comparison in respect of its fineness and its lightness with a variety having already given full satisfaction.

EXPERIMENTS WITH DICALCIUM PHOSPHATE.

It is well understood that in employing dicalcium phosphate (which is insoluble in water), phosphatation of the acid unlimed juice cannot be practised, since one would cause partial decomposition of the compound, and forthwith destroy the conditions desired. We would also add that from the chemical formula, 1 grm. of dicalcium phosphate will require 0·16 grm. of lime (CaO) for the formation of the tricalcium phosphate. This fact has frequently been verified in our experiments; though sometimes less lime is required, and the action of the phosphate is quite complex, certain basic matters in the juice also entering into composition to give rise to complex tribasic phosphates.

Experiment A.

First of all we give an example of a small scale experiment, using different quantities of phosphate, in order to ascertain its influence. Sulphited factory juice (the same in all the experiments) having a purity of 81° was used.

Test 1.—To 2 litres of juice limed to slight alkalinity 2·5 grms. of kieselguhr per litre were added, and the whole intimately mixed, being heated to boiling point while stirring. Filtration was very good, and the juice was slightly acid.

Test 2.—As before, but with a little more lime, in order to have a juice slightly alkaline. In this case, the filtration was very good, and the scums obtained were in the proportion of 23 kg. per 1000 litres of juice.

Test 3.—As in the others, but with still more lime, and adding 4·0 grms. of the phosphate per litre, that is a large quantity. Again, filtration was very good, and the scums produced were at the rate of 36 kg. per 1000 litres.

	Original Sulphited Juice	Filtered Juice.		
		Test 1	Test 2	Test 3.
Brix (by vol.)	17·77	18·58	18·33	18·38
Sugar, per 100 c.c.	14·40	15·36	15·16	15·21
Purity	81·00	82·70	82·70	82·70
Glucose per 100 c.c.	1·14	1·31	1·29	1·35
Glucose, per 100 of sugar	7·90	8·50	8·40	8·80
Ash, per 100 c.c.	0·48	0·53	0·50	0·47
Saline ratio	30·0	29·00	30·30	32·40
Lime (CaO) per 100 of sugar	—	0·36	0·40	0·33
Colour (Josse degrees per 100 of sugar)	—	17·00	—	16·00
Acidity, per litre	0·86	0·06	—	neutral.
Alkalinity, per litre	—	—	0·05	—

Here then is a case of a juice of average purity very appreciably improved with 1 grm. of the phosphate, and this would seem to be a sufficient dose, practically no difference having been produced with 4 grms.

Taking into consideration the purity, the quantity of lime salts is very slight. Then we have made some colorimetric determinations, and as shown the juice was very light in these tests, having only 16 or 17 Josse degrees per 100 parts of sugar.

Experiment B.

An example of a series of comparative experiments on sulphi-defecation and sulphi-phosphatation is now given, the same sulphited factory juice being used in all the tests.

Test 1.—Sulphi-defecation was carried out, the treated juice after filtration being found to be slightly acid. Kieselguhr was added at the rate of 2·5 grms. per litre.

Test 2.—Sulphi-defecation was again used, but the treated juice after filtration was neutral, kieselguhr being again added in the proportion of 2·5 grms. per litre.

Test 3.—Here sulphi-phosphatation with 2·5 grms. of kieselguhr and 1·0 grm. of dicalcium phosphate per litre was followed. Filtration was very good, and the treated filtered juice was neutral, while the scums obtained were in the proportion of 21 kg. per 1000 litres of juice.

Test 4.—Sulphi-phosphatation was carried out as in the preceding experiment, but with 2 grms. of the phosphate per litre. The treated filtered juice was found to be neutral, and the scums were at the rate of 28 kg. per 1000 litres of the juice.

The amount of lime (added in the form of milk) corresponded approximately to that required theoretically, or to that found necessary from the results already described. The analyses of the different juices are as follows:—

	Original Sulphited Juice	Sulphi-defecation		Sulphi-phosphatation	
		Test 1.	Test 2.	Test 3	Test 4.
Brix, by volume	19·00	20·09	20·07	19·63	19·77
Sugar, per 100 c c.	14·38	15·28	15·26	15·03	15·21
Purity	75·60	76·00	76·00	76·60	76·90
Glucose, per 100 c.c.	1·79	1·79	1·82	1·82	1·85
,, per 100 of sugar	12·40	11·70	11·90	12 00	12·10
Ash, per 100 c.c.	0·64	0·77	0·81	0·77	0·75
Saline ratio	22·50	19 80	18 80	19 50	20·20
Lime (CaO), per 100 of sugar	—	0·57	0·58	0 46	0·42
Colour, Josse degrees per 100 of sugar	—	18·0	24·0	20·0	18·0
Acidity, per litre	1·00	0·100	neutral	neutral	neutral

Here, then, is an example of the behaviour of a juice of about 76° purity, that is, rather low. One sees clearly the distinct rise of purity by the use of 1·0 grm. of phosphate, which is further accentuated by 2·0 grms. In all the tests which we have had occasion to carry out, this may be said to be the average increase.

When the reaction of the treated filtered juice is the same, there is less ash in the phosphated juices than in those not so treated. The difference with sulphited juices could be more pronounced in ordinary industrial working (without kieselguhr), when the scums and "bottoms" must be treated separately.

From the point of view of the lime salts retained, there is much less with phosphatation, and we may say that in general 0·10 to 0·15 of lime (CaO) per 100 of sugar less are obtained than in sulphi-defecation.

As to the colour, usually this is somewhat lighter—the reaction being equal, it is understood—a very important point, which must not be forgotten. In fact, precisely in this series of tests the two sulphi-defecated juices had 18° when acid, and 24° when neutral, showing a great difference arising solely from the different reaction. It is a well-known fact in the cane sugar industry that a juice will be lighter in colour in direct proportion to its acidity, and conversely darker if it is neutral, and more so if it is alkaline.

It often happens that the statement is made regarding a certain process of clarification that it decolorizes; but it is necessary to be very cautious in such conclusions, and to compare the different processes under exactly the same conditions of final acidity.

EXPERIMENTS WITH A FILTER-PRESS.

Example 1.—This test was carried out with factory juice, originating from cane that had accidentally been burnt and slightly deteriorated, but nevertheless having a relatively high purity, namely, 83°; 60 litres were limed to the necessary point, and afterwards treated with 2·5 grms. of kieselguhr and 2·0 grms. of dicalcium phosphate per litre, being intimately mixed for a few minutes in the cold. Subsequently, it was taken to boiling point while still stirring, and finally passed into the filter-press. In 2¼ hours 53 litres went through the press, which was then full, details being as follows :—At the end of 25 minutes, 22 litres had passed through, and the pressure had only reached 1 kg.; at the end of 45 minutes, 33 litres had gone through, while the pressure was 2 kg.; afterwards the pressure gradually rose to 4·0 kg. (that is when 44 litres had passed through), and this was maintained until the end.

The scums were washed with a little boiling water. On opening the press, it was noticed that the chambers were quite full, and the scums were compact. They had a total weight of 1·38 kg, that is at the rate of 26 kg. per 1000 litres (their water content being 56 per cent.), or 11·4 kg. of dry scums per 1000 litres.

	Sulphited.	Filtered.
Brix, by volume	18·28	19·35
Sugar, per 100 c.c.	15·24	16·25
Purity	83·3	84·0
Glucose, per 100 c.c.	1·14	1·16
Glucose, per 100 of sugar	7·50	7·20
Ash, per 100 c.c.	0·41	0·47
Saline ratio	37·10	34·60
Lime (CaO), per 100 of sugar	—	0·42
Acidity, per litre	0·80	0·05

Example 2.—These tests were made with factory juice having 79° purity, originating from sound cane; 2·5 grm. of kieselguhr were used per litre; and 1·0 grm. of the phosphate; while the quantity operated upon was 60 litres. In 2¼ hours 55 litres were passed through the press, of which volume about 25 litres went through during the first hour without pressure; 45 litres went through in 1¾ hours, when the pressure reached 2 kg.; and the rest passed through while the pressure rose gradually to reach 4·0 kg. at the end of the time stated. Two washings with boiling water were given, the first with 11·3 litres, and the second likewise, that is, each time with 100 litres per 100 kg. of scums. On opening the press, the scums were found to be very compact. They weighed 1·3 kg. with 60 per cent. of water, and only 3·0 per cent. of sugar. Hence, the wet scums from 1000 litres of juice were 23·6 kg.; and the dry scums 9·5 kg.

	Original Sulphited Juice.	Filtered Juice	First Washings	Second Washings.
Brix (by volume)	19·37	20·21	12·16	4·08
Sugar, per 100 c.c.	15·44	16·02	9·46	3·02
Purity	79·3	79·3	77·8	74·0
Glucose, per 100 c.c.	1·79	1·76	0·96	0·27
Glucose, per 100 of sugar	11·60	11·0	7·80	9·00
Ash	0·45	0·58	0·38	0·20
Saline ratio	34·30	27·60	24·90	15·00
Lime (CaO) per 100 of sugar	—	0·49	0·51	1·18
Acidity, per litre	0·95	Trace of alkalinity	neutral	neutral

There is thus no change in the purity, but for this purity there was only 0·49 of lime (CaO) per 100 of sugar, whereas at the same moment a factory working by sulphi-defecation and treating its scums gave a juice having only 78° purity and 0·63 of lime per 100 of sugar.

What is interesting is the analysis of the two wash-waters. Their Brix is influenced somewhat by that of the water employed, as is also the lime salts. But nevertheless the conclusion is clear, namely, to use only 100 litres of water per 100 kg. of scums (or, rather, to collect 100 litres of washings). This is, anyway, what has been generally practised.

Example 3.—In these tests a juice having about the same purity as in the preceding ones was used. The kieselguhr used was 2·5 grm.; and the phosphate, 1·5 grm. per litre; and 45 litres were passed through the press until after 2½ hours it was full, details of the filtration being as follows:—

Volume passed through	Time of Filtration.	Pressure at end of time stated
30 litres	50 minutes	2 0 kg.
41 ,,	2 hours	3·5 ,,
45 ,,	2½ ,,	4·0 ,,

When washing with boiling water, 11·3 litres were collected, that is, at the rate of 100 litres per 100 kg. of scums. The weight of the scums was 1·36 grm. (containing 60 per cent. of water, and 4·0 per cent. of sugar); the scums per 1000 litres of juice were 30 kg.; and the dry scums per 1000 litres of juice were 12 kg. The analyses of the juices were as follows:—

	Original Sulphited Juice	Filtered Juice	Washings
Brix (by volume)	17·58	18 17	12·75
Sugar, per 100 c.c.	13·86	14·51	10·14
Purity	78·8	79·8	79·5
Glucose, per 100 c.c.	1·44	1·58	1·11
Glucose, per 100 of sugar	10·30	10·90	10·90
Ash	0 44	0·47	0·37
Saline ratio	31·50	30·90	27·40
Lime (CaO) per 100 of sugar	—	0·28	0·35
Acidity, per litre	0·80	0·05	0·03

Some Considerations on the Combined Use of Dicalcium Phosphate and of Kieselguhr.

In cane sugar factories, in general, the work of extracting the juice is done by means of mills, with or without maceration. The juices are freely sulphited. Afterwards the liming and defecation of the juice are effected, and the clear juice and the scums and muddy liquors are separated by decantation, these latter being treated by fresh amounts of lime and passed to the filter-presses. The clear defecated juice as well as the filtered alkaline juice from the presses (which are mixed) undergo a prolonged boiling in eliminators, after which they are filtered in Philippe filters.

Depending upon the purity of the juice in process, different filtering surfaces are required, but, in general, the area is quite large, since the filters operate only after the lapse of a rather lengthy time. It follows that the liquids remaining in the filters represent a rather large volume of the cloudy juice, which is added to the scums in the eliminators, and this mixture is again treated with a little lime. After decantation, one obtains a clear juice, which is returned to the juice to be filtered, and also muddy scums which are united with the other scums for general treatment. Hence, the procedure is rather complicated.

One must therefore endeavour to find a process resembling those utilized in the sugar factory, giving by direct filtration through presses, on the one hand, the purified filtered juice, and on the other pressed scums. The filtered juice may be re-passed into the Philippe filters, acting as corrective, a quite limited number of these only being required, as they have almost nothing to do.

CONCLUSIONS.

From all the tests which we have made, and regarding which we have now given some examples, we have arrived at the following conclusions:—

(1) Sulphi-defecation in movement with the use of kieselguhr at the maximum rate of 2·5 kg. per 1000 litres of juice (or 2·0 kg. for juices of average purity) renders possible direct filtration through presses.

(2) Phosphates used in the defecation of the sulphited juice effect some clarification, and improve filtration. The rise of purity varies from 0·5° to 1·5°, according to the nature of the juice, and the proportions of the reagent employed.

(3) The use alone, however, of phosphates without kieselguhr does not allow of direct filtration through presses.

(4) Soluble phosphates added to effect filtration through presses demand large amounts of kieselguhr, so that the procedure lacks interest.

(5) Dicalcium phosphate, while acting in the same way as soluble phosphates, does not hinder direct filtration facilitated by the use of kieselguhr.

(6) One should employ 2·0 to 2·5 kg. of kieselguhr per 1000 litres of juice, and 1 to 2 kg. of dicalcium phosphate, and we advise a mixture containing 2 parts of kieselguhr and 1 part of dicalcium phosphate, of which mixture one should use 3 to 4 kg. per 1000 litres of juice. With 3 kg. one will effect the direct filtration of juices of average purity; but for juices of very low purity, it is necessary to use 4 and even 5 kg. The filtering surface necessary will be at most 50 sq. metres per 100 tons in 24 hours, and at least 25 sq. metres for juices of very high purity. These, then, are our conclusions, already announced in our previous article of 1913 to 1914.[1] We have now to speak of Guerrero's "Phospho-gelose," which we have had occasion to use on the large scale during the 1914 campaign.

Faulty Filter-Press Design.

By A DESIGNER

In large filter-presses with central supports as shown in the accompanying figure, the writer has actually, and repeatedly, seen blunders made in different drafting offices, with regard to dividing up the total loading of the entire press over the points of support at *A*, *B*, and *C*.

One of the worst cases is shown at "*a*" in the figure, and here the steel supporting structure was actually built to the wrong loading, which is seen to be badly out at mid-span when compared with the correct loading shown at "*b*." The trouble in all cases, despite the very elementary nature of the work, lay in solving the reactions at the three supports from the *distributed* load, and whence the party responsible for the loading "*a*" obtained his values is quite difficult to conceive. It looks like a bad guess. The case quoted here was that of a 40 in. iron press, and the correct method of dividing up the *distributed* load should be as follows:—

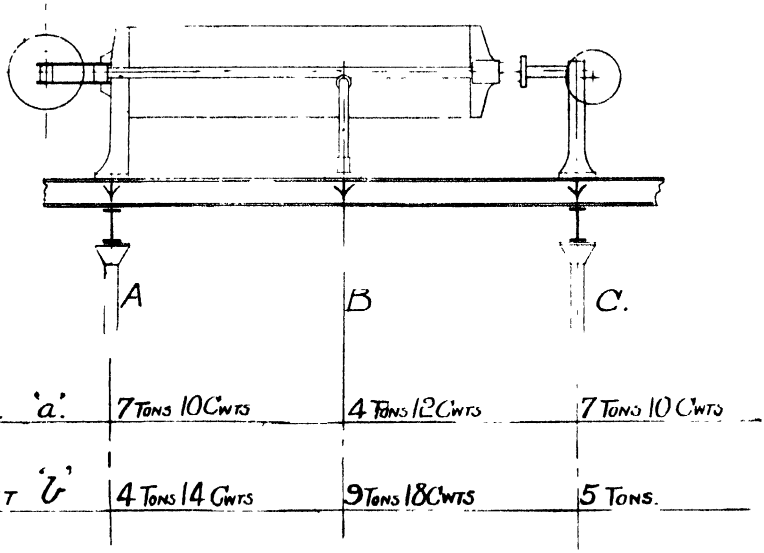
Total distributed load:—	Cwts.		
Two side bars	12	0	0
Iron chambers	75	0	0
Iron plates	192	0	0
Cloths	3	0	0
Cake	25	0	0
	307	0	0

---

[1] *I.S.J.*, 1914, 276–282; 362–367.

This is a total distributed load over two spans and from the theorem of three moments we get

	Cwts.		
Reaction at *A* $\frac{3}{16}$ × 307 =	57	2	0
,, ,, *B* $\frac{5}{8}$ × 307 =	192	0	0
,, ,, *C* $\frac{3}{16}$ × 307 =	57	2	0
	307	0	0



These respective reactions are now added to the concentrated loads as below—

Total reactions :—

				Tons	Cwts
A Concentrated	36	3	0	4	14
Distributed	57	2	0		
B Concentrated	6	0	0	9	18
Distributed	192	0	0		
C Concentrated	42	2	0	5	0
Distributed	57	2	0		
Total load ..				19	.. 12

The loadings given at "*b*" in the figure are totals and must be divided between the two sides of the press. The error incurred by assuming the plates and chambers to extend from end to end is quite inappreciable.

* * *

Professor W. B. Bottomley, of King's College, London, in a popular lecture said recently that he had obtained some remarkable results from the application of specially treated extract of peat to certain plants. He pointed out that there is a constant supply of plant fertilizer due to bacterial action on the soil, but that it is not sufficient to supply phosphate, potash, or nitrate to the soil. There must be organic matter. It is not possible to grow properly unless there is organic matter in the soil. Where is it to be obtained? There are millions of tons of waste peat bogs which could be converted into substances far more valuable and effective than the best animal fertitizers they could obtain.

The Employment of Electric Power in Sugar Factories.

By H. W. VAN DER LEE.[1]

(Specially translated by Ed. Koppeschaar.)

(Continued from page 136.)

ROTATORY CURRENT MOTORS.

In Fig. 6 we indicated the simplest form of a rotatory motor. The stator has three windings, connected on a rotatory current wire system. These windings may be connected in star or three-corner. In both cases the motor will get three connecting bars. The difference is, that for star connexion, the voltage difference at the terminals of each winding will be smaller than the three-corner connexion. With the latter the full wire voltage lies at each phase-winding, while with the first, two phase-windings are connected in series to the net voltage, and, as we have said, each of them has a voltage which will be smaller than the net voltage in the ratio of 1 : 1·73. In practice it does not make any difference to the user, provided the armature has been calculated for the proper voltage. With a single exception, to be named later on, the method of connecting may be safely left to the maker of the motor.

A rotatory field is excited in the stator by the three-phase rotatory current, and a weak iron core, revolvable round a shaft inside the housing of the motor, will follow this field in its motion. If this motion is not hindered, the iron core, called the rotor, will revolve with the same velocity as the rotatory field, i.e., *synchronous* with it, and the motor thus described we might call a *synchronous motor*. For driving a machine, however, or for doing other work, the action between the field and the rotor is intensified. This is accomplished by providing a winding on the soft iron core, through whose armature we send a continuous current. The rotor thus becomes an electro-magnet in itself, and the magnetic action between stator and rotor is strengthened considerably.

The synchronous motor, it will be noticed, is quite analogous to the rotatory generator, and in fact it may be used either way. The use of direct current for exciting can, however, be avoided. When a copper winding is placed on the iron rotor (which thus obtains the same form as the anchor of a direct current dynamo), E.M.F. will be excited within this winding, when it crosses the rotating field of the stator. When this winding forms a circuit, this E.M.F. creates a current, and the rotor will revolve. This revolving is caused by the magnetic action of electrical currents on a magnetic field, identical with the repelling and attracting action between mutual magnets.

In which direction will the motor revolve? According to the law of Lenz, an E.M.F. will have such a direction, that it counteracts the cause of its existence. The electrical current which is excited by the crossing of the lines of force by the rotor winding must counteract the crossing of lines of force by the winding. This takes place when the rotor turns in the same direction as the field of the stator. The counteraction diminishes as the speed of the rotor increases. How strong the current of the rotor will be depends on the velocity with which the rotatory field crosses through the winding of the also revolving rotor; thus on the motion of the rotating stator field relative to the rotor revolving in the same direction. When the rotor stands still, i.e., when starting the motor, this relative motion is greatest, and consequently the current of the rotor is also proportionately high.

Therefore, the motor will begin to revolve quickly, but the relative motion of the field of rotation in regard to the rotor is lessened by the greater speed of the rotor. In consequence of this the current of the rotor grows smaller. If it were possible for the speed of the rotor to reach the synchronous speed, i.e., if the rotor revolved at the same speed as the rotatory field, then the relative speed of these two would mutually become zero. The windings of the rotor, in that case, would not have crossed the lines of force of the field, and therefore no current would be excited any more in the rotor; thereby the cause of the co-revolving of the rotor would cease, and it would slacken its speed. Even if the motor is not loaded, the rotor always revolves more slowly than the rotatory field, and for the maintenance of the speed of rotation it is absolutely necessary that the rotor shall lag behind in its motion in regard to the field of the stator. For this reason this type of motor has been named an *asynchronous motor.*

Previously we have seen that a generator, which excites an alternating current of 50 periods per sec., must have a speed of 3000 revs. per min. when it has two poles, 1500 turns with four poles, etc. The opposite holds good also; when the winding of the stator has been made, so that two poles are present, and the motor is fed with rotatory current of 50 periods per sec., then the field of rotation will have a speed of 3000 revs. per min. According as the poles number 4, 6, 8, 10, etc., the speeds will be respectively 1500, 1000, 750, 600, etc., revs. per min.

The speed of the rotor is always less than that of the field of rotation. The *slip*, the difference between these two speeds needs to be only small. For larger motors it amounts to about 2 per cent. of the synchronous speed, and for smaller motors about 5 per cent., when the motor runs at full load. When the motor is loaded more heavily, the slip must be greater. The current which is excited in the rotor grows, and accordingly so does the attractive action which the field of rotation excites on the rotor. Practically, we may say that as the total slip represents only a very small value, the speed is constant with different loads. A four-pole motor for rotatory current of 30 H.P., when connected to a wire system having a frequency of 50 periods per sec., will make 1500 revolutions when running light, and this speed will slacken to about 1450 revs. per min. when loaded fully to 50 H.P. Why a small slip should be sufficient to excite the necessary rotor current must be attributed to the very small resistance of the rotor-winding. It will be remembered that the force of an electrical current depends directly on the resistance of the circuit. If the resistance be small, then a low voltage will be sufficient to force a certain current through the circuit. If a current of 10 amps. is to be excited in a circuit which has a resistance of 5 ohms., then the voltage needed will be 5 × 10 = 50 volts. If the resistance, however, be only 0·5 ohm., then a voltage of 0·5 × 10 = 5 volts will be sufficient.

When we learn that the rotor-winding of an asynchronous motor is made of short-circuited armatures, we understand that a low voltage will be sufficient to cause a strong current, because the resistance is small. This voltage is excited by the crossing of the lines of force of the rotating field by the rotor, and it is the slip which causes this crossing. Therefore the slip need only be small.

It will now be clear also that, when such a motor with short-circuited rotor is started, the initial current will be very large. At the moment that the stator is connected with the system—accomplished with the aid of a three-poled connecting bar—the rotor is standing still, while the rotatory field, which is created immediately, revolves at full speed. The slip at that moment is 100 per cent. and the starting current very high, i.e., about four to six times the full-load current of the motor. Such rushes of the current cannot be admitted on the circuit, especially not when lamps are also connected. The light would flicker. This method of starting, therefore, is used only for small-size motors. The methods which are used for making the starting current smaller are obvious; firstly, the rotary field may be rendered weaker during the starting period, whereby the excited rotor-voltage, and also the rotor current, will be smaller; and secondly, one can enlarge temporarily the resistance of the rotor, in which case the rotor current is also kept within certain limits. For the first method one uses a star three-corner connecting bar or a starting transformer.

When a motor is built in such a way, that the stator armature is connected in three-corner, then each of the three-phase windings will be on the full net voltage in normal working, for example 220 volts. If temporarily, during the starting period, the motor be connected in star, then, as we have seen above, each time two-phase windings will be connected in series, at 220 volts, and each winding gets 127 volts to its account. By thus reducing the voltage at each of the three-windings temporarily from 220 to 127 volts, the rotatory field is made weaker and the motor starts with a weaker current. Starting by means of a three-corner connecting bar is accomplished in two stages, and can be resorted to only with motors which normally run in three-corner connexion.

A transformer is a contrivance which transforms rotatory current from one voltage into another. It will be dealt with later on. If, when a rotatory current-motor is started, one interposes a transformer between its terminals and the circuit, one has the means to feed the motor temporarily with a voltage which is lower than the voltage of the circuit.

When, furthermore, the transformer has been arranged so that we can increase the voltage of the motor in two or more stages, then it will be apparent that this furnishes a very good method to bring the rotatory field gradually up to its normal load, and to start the motor with a current which is not unduly heavy. The second method named, i.e., increasing the resistance in the circuit of the rotor during starting, is used for motors with *slip rings*. Here the rotor armature is not short-circuited in itself, but is connected for instance in star, and the three terminals of the phase-windings are connected with as many slip rings placed on the shaft of the motor. On these slip rings three brushes are resting, which are connected by insulated wires with a starting resistance. When starting the motor, the whole value of the resistance is taken up in the circuit of the rotor. When the stator winding of the motor is again connected by a three-poled connecting bar to the rotatory current circuit, the rotatory field will be created immediately at its full strength; but even if at this moment the slip be 100 per cent., the starting current is suppressed by the resistance which is connected with the motor. Gradually, with the motor reaching full velocity, the starting resistance is reduced, and finally when the motor has reached full speed the resistance is short-circuited completely. Usually these slip ring motors are provided with a contrivance which makes it possible to unite the slip rings mutually when the motor runs at full speed, thus giving the motor a normal short-circuited rotor. At the same moment the brushes on the slip rings are lifted, in order to avoid wear and friction losses.

The contrivance which serves to short-circuit and lift the brushes from the slip rings is worked by the aid of a handwheel or lever at one of the bearings of the motor.

Summarizing, it may be said that the asynchronous motors are divided into (*a*) motors with short-circuited rotor, which are started, according to their size, with a three-poled connecting bar, a star three-corner connecting bar, or a resistance or transformer; (*b*) motors with slip rings for rotor windings, to be started with a three-poled connecting bar and starting resistance.

THE TRANSFORMER.

The object of a transformer is to change alternating current of a certain voltage into similar current of different voltage, that is higher or lower. It has no rotating parts, nor does it call for any supervision. Thanks to these transformers, the use of alternating current has found a much more extensive application than has direct current.

For the latter type, one may build machines which produce a fairly high voltage with the possibility of transmitting electrical energy over a long distance; but the tapping and use of this high voltage direct current is dangerous and presents many difficulties. In the case of alternating current this objection does not hold, and by means of transformers the dangerously high voltage can be changed down into a much lower one, easier to handle, and free from danger.

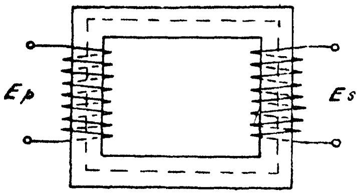


FIG. 10.

In Fig. 10 the principle of the transformer is made clear. Here a laminated soft iron core is provided with two windings; one of these, the *primary* (*Ep*), receives the alternating current whereby a magnetic field is created in the iron, the polarity of which is reversed by, and with the same periodicity as, the alternating current. The shape of this core is such that the lines of force of the field go right through the iron as indicated by the spaced line. Inside the second winding, the *secondary* (*E s*), comprising the entire group of lines of force, the magnetic field changes its direction and force continually.

As will be remembered, an E.M.F. will be created in a conductor which is cut by the lines of force of a magnetic field. Whether the conductor is moved through the field, or the field moves in relation to the conductor, does not make any difference. It is not even necessary that motion should take place, for an E.M.F. is created in the conductor even when this stands still in a magnetic field whose force keeps changing. The greater the change of field, the greater the E.M.F. If the intensity of the magnetic field grows, the E.M.F. will have another direction than that when the field grows weaker. This is the case with a transformer. The primary winding through which we send an alternating current gives rise to a changing magnetic field, and this latter in turn creates an E.M.F. in the secondary winding, which will have the same form as that supplied to the primary winding. If we connect a series of lamps or other user of current with the secondary winding, then the voltage which is secondarily induced will give rise to an alternating current. The force of the secondary E.M.F. is in direct proportion to the number of turns in the coils which constitute the secondary winding. Thus, in order to induce a current of higher or lower voltage than the current in the primary winding, the number of convolutions of secondary windings must be respectively greater or smaller than those on the primary side.

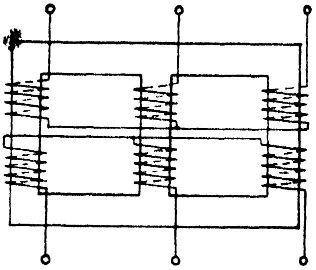


FIG. 11.

With 3-phase alternating current transformers, the primary and secondary windings are in sets of three, each with a corresponding number of cores; but the method of connecting up is variously arranged in practice, many different combinations being met with. In Fig. 11 a 3-phase alternating current transformer is shown diagrammatically, both primary and secondary windings being connected in star, i.e., one terminal of each of the 3-phase windings is connected together, while the other end is led to a terminal to which we may connect the wire either supplying the energy or to be supplied. It must be noted, however, that contrary to the real design of these transformers, the primary and secondary windings have here been drawn of equal dimensions.

Transformers are usually placed within sheet-iron casings filled with oil· This oil has a threefold utility; in the first place, it forms an efficient insulation between the high voltage winding and the low voltage one, and insulates both from the iron core; secondly, the windings are better protected; and in the third place, the oil acts as a cooling medium by absorbing the heat generated by the losses in energy which always occur, and which are transformed into heat. (In the case of a motor, the rotation causes a draught, usually improved by artificial aids, which keeps the machine cool.) The oil will circulate on being warmed, and will radiate its heat to the iron casing, and thence to the air. In the case of large units, however, water cooling through serpentine pipes is resorted to as well.

THE PHENOMENON OF SELF-INDUCTION.

As we have explained above, an E.M.F. of variable strength and direction is excited in a winding which is at rest and wound round a core, the latter being magnetized and the strength of the field changed. But this E.M.F. is not only excited in the secondary winding of a transformer, but in the primary winding as well. Thus what actually happens is this: we feed an alternating current into the primary coils of a transformer; a magnetic field is created thereby, which in turn creates an E.M.F. in the same coil, described as the electromotive force of self-induction. This E.M.F. will obviously influence the incoming current The voltage which we introduce into the transformer must create a fresh current, and at the same time overcome the E.M.F. of self-induction. The result is that the final current proves to be smaller than if no self-induction had been set up. Moreover, the latter causes a shifting of the phases between current and voltage. This action may be compared with one where a weight is suspended from a spring, and the free end of the spring is moved up and down, while the weight will stretch the spring more or less. When the upper end of the spring goes up, the weight will not follow this motion simultaneously, but be a little late, so that at the moment when the end of the spring goes down again, the weight has not as yet changed its direction of motion similarly. Again, when the point of suspension is moved up once more, the weight tends to go on on its downward motion until the tensive force of the spring has become great enough to make it reverse its direction. Thus the motion of the weight will take place with the same regularity as that of the point of suspension, only the weight will always be a bit behind, i.e., the weight shows a shifting of phase as compared with the motion of the point of suspension. The cause of this shifting is to be found in the inertia of the weight.

Similarly, we have the action of self-induction in the alternating current circuit. The voltage of the supply corresponds to the force which moved the point of suspension of the spring, and has likewise a periodical course. The velocity of the motion of the weight coincides with the intensity of the current in the circuit, and this will lag behind in respect to the voltage on account of the E.M.F. of self-induction, which plays the rôle of the inertia attached to the weight when being moved. The inertia action of the self-induction consists in its slackening the intensification of the current at one moment, and retarding the decrease in its strength at another; the intensity of the secondary current reaches its maximum value a moment later than does the voltage, and will pass the zero point the same time-interval later.

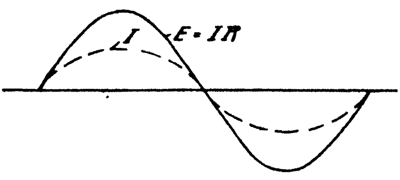


FIG. 12.

Fig. 12 shows a current in a circuit, where self-induction is absent, through the absence of any iron that would be magnetized by the primary current; this current *I* is in phase with the voltage *E*, developing its maximum and minimum values at the same moment. In Fig. 13 the intensity of the current is also marked by spaced lines, and at the point *B*, where the current is at its maximum value, the voltage has already passed its maximum. This figure corresponds to an alternating current circuit with self-induction, i.e., as in motors, transformers, brake-magnets, and the like. A full period, as drawn in the figure, coincides with a complete rotation of the generator, that is, if this is a two-pole machine; or with a traversed angle of 360° (electrical). The part of the period, *A B*, between the points where voltage and current reach their maximum value, can also be expressed in angle measure, and is usually represented by the Greek letter φ, which indicates the angle of phase-shift between voltage and current.

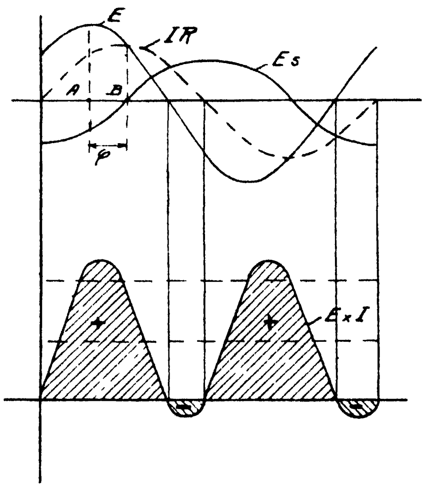


FIG 13.

When a load is displaced, the energy which must be spent to do it can be expressed by a factor consisting of forms of force multiplied by distance. Thus the labour accomplished by a pump may be found by multiplying the quantity of fluid which is displaced by the pressure which has to be overcome. The electrical labour analogous to this may be expressed by the product of the voltage and the quantity of electricity which is displaced, while the electrical energy may be calculated by voltage × amperes. For direct current this is easily determined, as voltage and current are constant. With alternating current, however, voltage and current change every moment.

In the case shown in Fig. 12 of a circuit without self-induction with current and voltage changing continually, the question is still fairly simple. We can take the product of voltage and current at some moments during a period and note the average value of these products. But then we get the same result by multiplying the average values of current and voltage in order to find the energy.

In a circuit with self-induction, however, where current and voltage are not in phase, this will not hold good. In Fig. 13 a wave line is drawn to scale which gives from point to point the product of the corresponding points on the sine curve E and I which represent the voltage and current. The mean plane is a measure of the work which is accomplished during a full period. At some moments, it will be noticed, the work will be negative, which moments will be when current and voltage have negative value. It will be apparent that the height of the wave line and, consequently, the content will be smaller, the more the points A and B when voltage and current are at their maximum lie apart; while the work done in the period will be greatest when the maximum values of current and voltage coincide, i.e., when no shifting of phase takes place. Consequently the extent of the phase displacement between current and voltage affects the work accomplished by the alternating current.

When E and I represent the average values of voltage and current, and *cos.* ϕ, the cosine of the angle of phase displacement between voltage and current, then $E \times I \times$ *cos.* ϕ will be the energy in a circuit of alternating current with self-induction. As regards the influence of this *cos.* ϕ on actual practice, we must note that it will always make the work done by a certain voltage and current smaller. Hence we need a greater current than if there were no phase shifting.

If we take a half-watt lamp of 1000 C.P., using half a watt per candle or 500 watts in all, this will if connected with a 125 net voltage take 4 amps. An alternating current motor, however, which uses 500 watts will need a bigger current with the same voltage. The *cos.* ϕ of such a motor is about 0·7, hence instead of 4 amps. the current needed will be about 5·7 amps. (125 volts × 5·7 amps. × 0·7 = 500 watts). This factor, *cos.* ϕ, is also called the *power factor*, since it indicates what part of the product, current × voltage, or volts × amps., will be obtained as actual power.

What proportion of this *cos.* ϕ is obtained is obviously of some importance. If two generators furnish current, the one to a number of glow lamps, and the other to a number of motors, and both cases require a similar amount of energy, then the first generator requires to furnish less current than the second. Generator and wiring can accordingly be calculated for this smaller current. On the other hand, a generator may be loaded the heavier, the smaller the phase displacement be between the current and the voltage. Thus it is important whether the current users connected to a central supply have much or little self-induction, and therefore minimum values are universally stipulated for motors which have to be connected up. By careful design and construction of the motor, the risk of the power factor sinking below a certain minimum can be guarded against.

Because of self-induction, the power of alternating current generators and transformers is not given in kilowatts as with direct current machines, but in *kilo-volt-ampères* (K.V.A.). The load which is admitted to a generator is limited by the ensuing development of heat, i.e., a temperature rise of 60° C. must not be surpassed. This heating depends directly on the current density; it therefore forms the measure of the load which can be borne. The load stated in kilowatts will be the greater as the power factor is greater. An alternating current generator of 100 K.V.A. at 500 volts can give a current of 200 amps. When it is fully loaded with motor work having an average *cos.* ϕ of 0·8 (the phase displacement in this case will amount to 37°), then the output will be 500 × 200 × 0·8 = 80,000 watts or 80 kilowatts.

If, however, the generator be loaded with glow lamps where *cos.* ϕ will = 1, because there is here no phase displacement, the energy produced will be 500×200 = 10,000 watts or 100 kilowatts.

As already shown above, the rotary system is created by the combination of three one-phase alternating currents. For each of the three circuits (see Fig. 7) the energy will be $E \times I \times \cos.\ \phi$. Consequently for the rotatory system it will be $3 \times E \times I \times \cos.\ \phi$. In this formula E represents the voltage of each of the phase windings. For the net voltage of the rotatory system (Fig. 8) we found a value however which was $\sqrt{3}$ or 1·73 times as great as the phase voltage. When we insert the net voltage instead of the phase voltage in the above formula, the energy of a rotatory circuit will be expressed by the product

$$3 \times \frac{E}{\sqrt{3}} \times I \times \cos.\ \phi \quad \text{or} \quad 1{\cdot}73 \times E \times I \times \cos.\ \phi.$$

A rotatory generator having a voltage of 220, and delivering a current of 300 amps. to users which give rise to a $\cos.\ \phi$ of 0·83, will consequently generate an energy of $1{\cdot}73 \times 220 \times 300 \times 0{\cdot}83 =$ about 95,000 watts or 95 kilowatts.

(To be continued.)

The Simplified Inversion Method proposed by Walker.

By H. PELLET.

Mr. HERBERT S. WALKER, of the College of Hawaii, has proposed a new so-called "simplified" method of inverting sugar solutions, pure and impure.[1] This chemist has carried out a series of experiments which convinced him that, by adding hydrochloric acid to a liquid previously raised to a temperature of 65°C., and allowing the whole to cool in the air during at least 15 minutes, results constantly comparable with those given by the Herzfeld method were obtained.

We cannot see precisely the advantage of this procedure, and where its simplicity lies. In fact, when we made a few observations upon the Steuerwald method, it was because it was long, since in practice one aims at having the results of an analysis in the shortest time possible.

Now the new method proposed by Mr. WALKER does not give a result more rapid or more simple than that generally in use. By means of the Herzfeld modification of the original Clerget process, one effects the inversion after at most 10 to 12 minutes; and under the conditions followed the operation is without complication, since a determined volume of hydrochloric acid and some water is mixed with the liquid to be inverted, rapidly raised to 70° C., and maintained five to seven minutes at this temperature to complete inversion, being finally cooled, and the observation made. Working in this way, one may easily carry out 5–10 determinations at the same time.

It may be remarked further that Mr. WALKER does not appear to use the acid polarization of the liquid before inversion, and this under the conditions studied by ANDRLIK, OGILVIE, and the author, in order to have a polarization more comparable with that obtained after inversion. Depending upon the nature of the impurities contained in the molasses, the quantity of lead remaining after clarification, or the treatment by means of different reagents, the direct polarization of the liquid is more or less inexact, for this polarization is modified by acidification before any transformation of sucrose into invert sugar can take place. This has been shown by divers experiments.

It is known that if a solution of hydrochloric acid containing urea be used, it is possible to acidify a clarified solution of molasses without inverting the sucrose, at least for some time; and further that by acidifying the same solution of molasses with concentrated sulphurous acid, practically the same results are obtained; while sulphurous acid has the advantage of decolorizing the solution, and of not acting upon the sucrose at the ordinary temperature, that is, during a much longer time than that necessary for the necessary operations involved in making the observation.

---

[1] *I.S.J.*, 1917, 31.

Consequently, it is necessary to use the acid direct polarization for comparison with the inversion polarization; otherwise the results are inexact. It is possible to bring forward quantities of figures in support of what has just been said; but we are contented to reproduce the table published by Mr. OGILVIE,[1] as follows:—

	Cuban molasses		Egyptian molasses	Java molasses.	"American syrup."
	No. 1	No 2.			
Ash (sulphated)	6·77	7·34	10·92	10·97	6·05
Reducing sugars	18·71	18·56	11·70	21·98	26·55
1. Alkaline (basic lead acetate) polarization	32·20	31·40	39·50	34·30	39·70
2. Neutral direct polarization	30·50	29·90	38·10	33·46	39·65
3. Acid (HCl and urea) polarization (Andrlik)	30·50	30·50	38·40	33·38	39·26
4. Acid (SO_2) direct polarization (Pellet)	30·60	30·50	38·30	33·30	39 10
5. Invertase inversion polarization	—16·40	—15·50	—17·90	—14·08	—11·40
6. Acid inversion (Herzfeld) polarization	– 16·30	—15·40	—18·02	—14·06	—12·28
7. Percentage of sucrose, using invertase as hydrolyst	35·6	34·4	42·4	36·1	38·7
8. Percentage of sucrose, using acid as hydrolyst, and the alkaline direct polarization	36 7	35·4	43·4	36·6	39·3
9. Percentage of sucrose, using acid as hydrolyst, and the neutral direct polarization	35·4	34·2	42·4	35·9	39·2
10 Percentage of sucrose, using acid as hydrolyst, and the acid (HCl and urea) direct polarization (Andrlik)	35 4	34·7	42·6	35 9	38·9
11 Percentage of sucrose, using acid as hydrolyst, and the acid (SO_2) direct polarization (Pellet)	35·5	34·7	42·5	35·8	38·8

Thus it is seen that, no matter which product, the action of sulphurous acid or of hydrochloric acid containing urea is the same; and further that certain cane molasses give an acid direct polarization (using either sulphurous acid or hydrochloric acid containing urea) that very closely approaches the neutral direct polarization, and sometimes is even higher. In any case, it is evident that one must always carry out the acid direct polarization previous to inversion, which polarization should only be compared with that obtained on inversion for the calculation of the sucrose.

With beet molasses, this acid polarization before inversion is equally necessary, for the difference between the ordinary direct and the acid direct polarizations may be very marked. Citing also the figures obtained by Mr. OGILVIE[2] for beet molasses, we have:—

---

[1] *I.S.J.*, 1912, 91.

[2] *I.S J.*, 1911, 150.

SAMPLE.	1.	2.	3.	4.
Direct alkaline (basic lead acetate) polarization	48·8	—	48·6	47·0
Direct neutral polarization	49·2	52·0	49·0	47·6
Direct acid (Andrlik) polarization	50·4	53·25	50·0	48·4
Direct acid (Pellet) polarization	50·3	53·3	—	48·3
Invertase inversion polarization	—14·6	—16·0	—15·0	—14·4
Acid inversion polarization	—13·2	—14·6	—13·6	—13·8
Clerget value by invertase	48·5	51·7	48·6	47·1
Clerget value by acid, using alkaline direct polarization	47·0	—	47·1	46·1
Clerget value by acid, using neutral direct polarization	47·3	50·4	47·4	46·5
Clerget value by acid, using acid (Andrlik) direct polarization	48·2	51·4	48·2	47·1
Clerget value by acid, using acid (Pellet) direct polarization	48·1	51·4	—	47·0

We might also give our own figures confirming those of Mr. OGILVIE; but we will simply point out that for certain beet molasses we have had an acid direct polarization as much as 2·5 per cent. greater than by the ordinary direct polarization, though most generally the difference is 1·0 to 2·0. It results from this that the percentage of sucrose calculated from these acid direct polarizations closely approaches the direct ordinary polarization; whereas the sucrose calculated from the ordinary direct and inversion polarizations gives results always too low and sometimes considerably so.

Therefore, it would seem to be absolutely indispensable when carrying out any inversion determinations whatever to ascertain the acid direct polarization of the liquid, this especially by means of sulphurous acid, following the directions of the author, published in different articles, and this no matter which mode of inversion be afterwards followed, though for our part we prefer the Clerget system with the details indicated by Herzfeld, since this furnishes rapid results.

However, we would make yet another very important observation, namely, that it is almost impossible to be certain of complete inversion, particularly when examining cane molasses, unless one has carried out two tests under somewhat different conditions. Depending upon the chemist, very different quantities of basic lead acetate may be used for the clarification of the molasses solution. Some add a certain volume of this defecating agent without noting whether the liquid after filtration gives or does not give a further precipitate with another addition; but others on the contrary (among whom is the author) ascertain the volume of basic acetate necessary to precipitate all that can be thrown down without an excess of the reagent, obtaining thus the full clarification with the maximum decoloration.

This quantity of basic lead acetate is generally very variable and very considerable in the case of cane molasses. For example, we have calculated that for a certain cane molasses, it was necessary to use 130 c.c. of basic lead acetate solution (sp. gr., 13·25), prepared according to the French Codex, whereas another required 250 c.c., that is almost double.

Mr. WALKER has analysed a molasses which required 80 c.c. of basic acetate (of what strength?) for 71·50 grms. of molasses, that is, 112 c.c. per 100 grms. of molasses, but he does not state whether a precipitate was no longer produced. Depending upon the quantity of basic acetate added for clarification, a greater or less amount will pass into the filtrate, the liquid thus neutralizing a portion of the acid (often a large one) added for inversion.

It is for this reason that the duration of inversion may vary, especially in the case of very impure solutions of molasses requiring a large amount of basic lead acetate.

In consequence, being unable to make certain of the necessary duration of inversion, we have advised the precaution of proceeding in duplicate. Into two flasks, 50 c.c. of the liquid, 5 c.c. of concentrated hydrochloric acid, and 25 c.c. of sulphurous acid (sp. gr., 1030-1035) are placed, this latter being to prevent the coloration of the liquid. The two flasks are rapidly heated at 70° C. (the internal temperature), one afterwards being kept at this temperature during seven minutes, and the other for ten. After cooling the contents of the flasks, and allowing them to stand for a certain time (about 20 minutes) to avoid muta-rotation, they are completed to 100 c.c., some special decolorizing carbon being added, and the observation made as usual. In this way, by means of the second flask, one verifies the completion of inversion, provided the result corroborates the first.

If, however, the second test, as we have noticed sometimes happens, gives an appreciable increase of the polarization of the first, the determination is repeated again in duplicate; but this time heating the first flask for 10 and the second for 12 or 13 minutes after the temperature of the contents has reached 70° C. It is seldom that inversion is not completed under these conditions. Naturally, account is taken of the content of the inverted sugar solution after inversion, in order to apply the constant, which is known to diminish in proportion as the amount of sugar decreases in total invert sugar after inversion.

We also see that Mr. WALKER proposes the addition of aluminium sulphate, though only for the direct reading, in order to reduce the influence of the excess of lead; but this addition does not give a liquid having a polarization equal to that in the presence of sulphurous acid, or hydrochloric acid and urea.

It would therefore be desirable, once for all, to arrange in carrying out the Clerget inversion (whatever the modification adopted, HERZFELD, STEUERWALD, WALKER, or other) that the acid direct polarization before inversion be made, and to use this polarization for the calculation of the sucrose with the result of the inversion.

We propose the use of the sulphurous acid for effecting this acid direct polarization, on account of its great advantages over a hydrochloric acid containing urea, and of its accuracy, as proved by various chemists, notably by Mr. OGILVIE.

The decision of the United States to go to war with Germany will of course deprive the former of their one time almost exclusive source of beet seed. But thanks to imports of seed from Russia, and the home production which now equals one-fourth of the demand for America's domestic sowings, the 1917 crop is assured an ample supply of seed. In five years, says *Facts about Sugar*, the States hope to produce all the seed needed and may even be in a position to export. The Department of Agriculture is actively encouraging the new industry.

The *Board of Trade Journal* quotes a Japanese paper for the statement that a large company has recently been formed in Tokio with a capital of ten million yen (£1,020,800) for the purpose of establishing a beet sugar industry near Mukden, Manchuria. The project includes the construction of a large beet usine equipped with suitable machinery, and a sugar refinery attached. The output will be sold in Manchuria and North China, its distribution being facilitated by the South Manchuria Railway Co. The company does not propose itself to cultivate beet, but will encourage the native farmers to do so, probably by advancing money or by providing trained experts for their practical guidance.

Central Stewart, Cuba.

Central Stewart, the mammoth sugar factory of Central Cuba, was the pioneer ingenio in the Ciego de Avila district of the province of Camaguey. It was built in 1907 by Messrs. Duncan Stewart & Co. Ltd., of Glasgow, from whom it takes its name, and was originally designed to deal with 2300 tons of cane per day. Extensions were made year by year until it now has a capacity of over 6000 tons of cane per day. From its inception until the end of the 1916 crop Central Stewart was the property of the Stewart Sugar Company of New York, but in 1916 the entire concern was sold to the Cuba Cane Corporation.

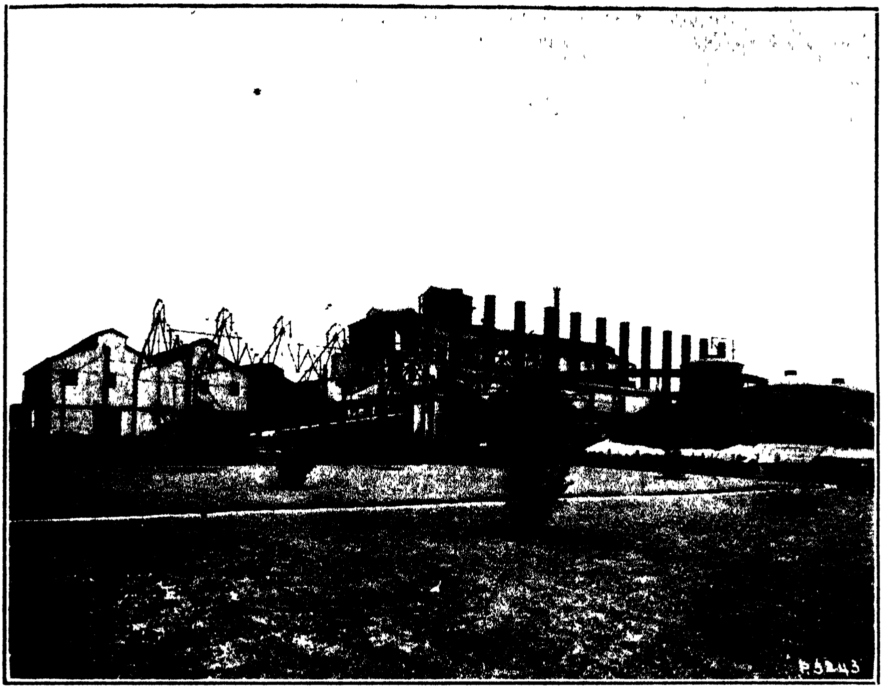
The factory and estates lie about ten miles south of the town of Ciego de Avila on the Júcaro and Moron Railroad, and the town of Stewart possesses its own post office and telephone system. The estate covers an area of over 1300 *caballerias* (over 43,000 acres) and is intersected by more than 60 miles of standard gauge railroad with a full complement of heavy locomotives and cane and sugar cars. Communication with the Cuba Railroad at Ciego de Avila (the main line linking up Havana with Santiago) is maintained by petrol and steam railroad motor cars besides the public train service on the Júcaro and Moron Railroad. For several years the sugar produced by the factory was shipped through the port of Júcaro, but later the sugar company established a private railroad to Palo Alto and constructed wharves and a pier to accommodate ocean going steamers. From this port communication with the town of Cienfuegos is obtained by motor boats.

The cane is gathered from the fields in bullock carts holding about 5½ tons each, and the full carts are taken to the nearest loading station where a crane lifts the whole load from the cart and places it in a 30-ton railroad cane car of special design, having a doubly sloped bottom and sides hinged at the top. Trains are made up of the loaded cars and the cane is thus transported to the factory where, in passing over large cane hoppers after being weighed, the cars are unloaded by loosening the sides, thus allowing the cane to fall into the hopper. Massive steel chain and hook elevators lift the cane from the hoppers and deliver it to the crushers.

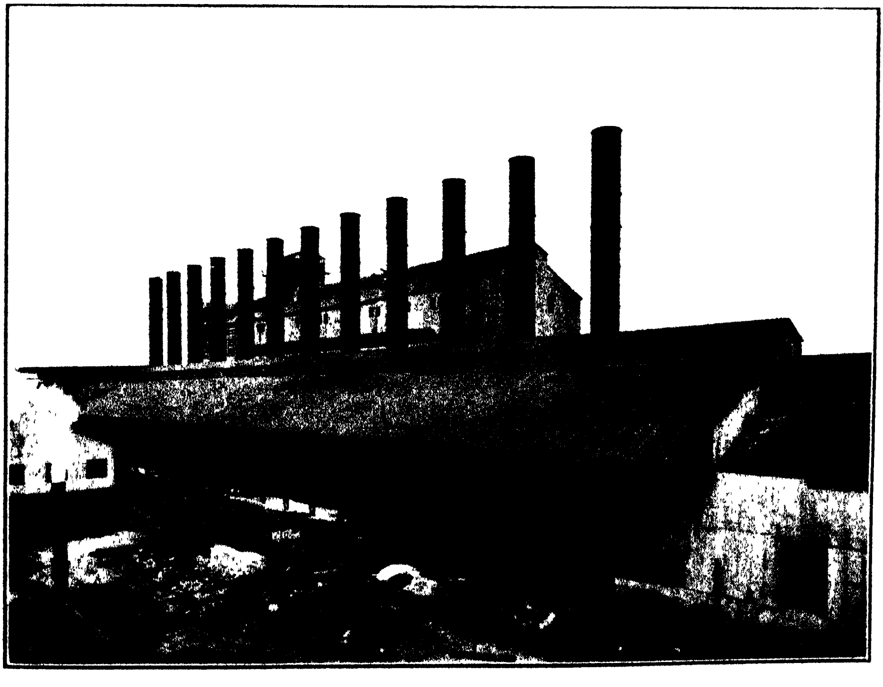
The factory itself is housed in buildings constructed entirely of steel, and comprises the mill, sugar, boiler and scum houses. Central Stewart is designed on the high system, that is to say, the raw juice coming from the mills is pumped once only, rising to the top floor of the sugar-house and passing successively through the various stages of heating, purification, concentration, crystallization and curing, as it descends by gravity, finally emerging as 96° polarization sugar on the ground floor.

The milling plant consists of three trains of 36 in. mills—two trains being 6 ft. wide and the third 7 ft. wide—each with a Krajewski crusher. Each train is driven through cast-steel machine-cut gearing by one 50 in. × 60 in. steam engine. The mills are fitted with the well-known Stewart patent hydraulic attachments, and have cast-steel cheeks and nickel steel gudgeons. The bagasse from the mills is delivered by short carriers to the main bagasse carrier which distributes it to the boiler furnaces.

The raw juice from the mills is automatically strained and is pumped up to the top floor of the sugar-house, where it undergoes the first stage of treatment by passing through the juice heater. From the heater it flows to the next floor where it is distributed to the defecators. After defecation the clear juice is discharged into the quadruple effect supply tanks, whence it is drawn by the quadruple effect

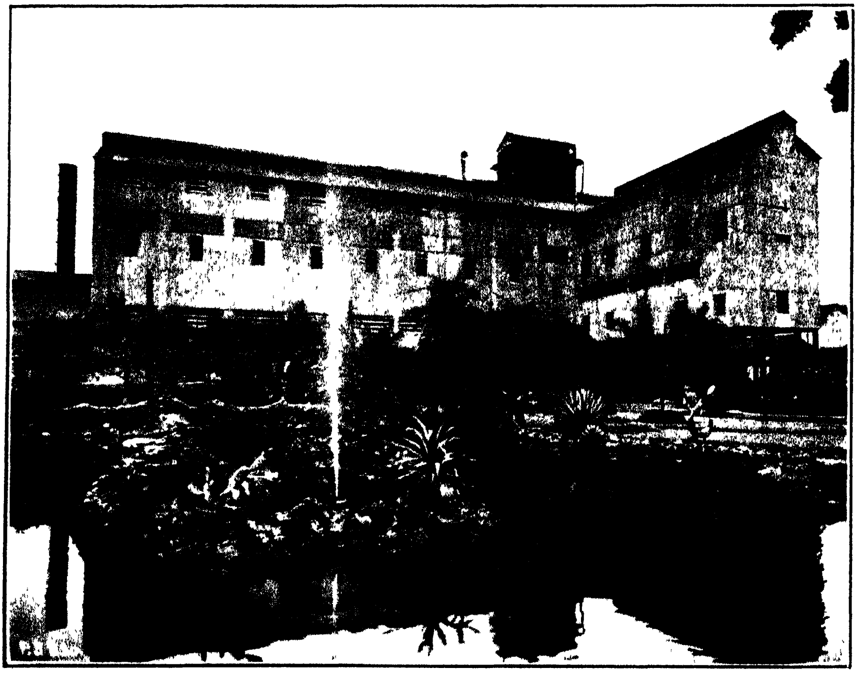


General View of Central Stewart



Central Stewart.—View of Boiler House.

Central Stewart—View of Gardens



Central Stewart—View from Gardens

evaporators, of which there are four. The syrup is distributed to the syrup tanks, from which it passes as required into the vacuum pans, six in number. The massecuite is discharged from the pans either into the crystallizers or directly into the strike mixers above the centrifugal machines. The massecuite, fed into the mixers from the crystallizers or directly from the pans, is cured in the centrifugals, of which there are 42, each having a basket 40 in. in diam. The dry sugar is transported by conveyors and elevators to bins where it is bagged and weighed.

The scums are treated in the scum-house by a battery of 18 filter-presses, each having 50 chambers 40 in. × 40 in. The scums are pumped into the presses by a powerful scum pumping engine and the clear juice is returned to the sugar-house for concentration. The press-cakes are collected in special railroad cars which pass beneath the presses, and the filter cloths are dealt with by two power-driven washing and wringing machines.

The vapour from the evaporators and vacuum pans is dealt with by three condensers served by two large centrifugal water pumps, one large reciprocating water pump and a dry vacuum pumping engine. The injection water is cooled in a large cooling tower of the open type to which it is conveyed by an overhead steel flume.

The steam generating plant consists of 24 multitubular steam boilers, each 8 ft. dia. by 22 ft. long. These are set in pairs over 12 bagasse furnaces automatically fed with bagasse from the mills, and each furnace is provided with a separate self-supported steel chimney.

The factory with its various offices and the town are lit throughout by electric light. Potable water is obtained from a deep well from which the liquid is pumped to a high storage tank. The factory possesses a well-equipped machine shop, a blacksmith's shop, a fitting shop, a carpenter's shop, a large sugar store, large molasses storage tanks and pumping plant, and an ice factory.

Perhaps the most picturesque portion of the landscape at Stewart is the garden attached to the General Manager's house. This was arranged by the late Mr. O. E. DAVIS, who was the general manager at Stewart from the first crop until the time of his death in 1915.

The town of Stewart possesses, of course, the usual *tienda* or general store, and the *fonda* or restaurant at which all the unmarried employees take their meals, as well as a fully equipped hospital. As is usual in Cuban factories, the married employees are provided with separate bungalows, and there are several *casas de vivienda* or living houses in which the unmarried employees have rooms. A sumptuous and spacious new *casa de vivienda*, however, which will serve as a guest house and for other purposes, is now being erected at a cost of $130,000 for the building alone, and when the surrounding gardens and the ornamental grounds round the factory are finished the situation of Central Stewart promises to be one of the most beautiful in Cuba.

On the accompanying plate are shown four views illustrating this factory and its picturesque surroundings. These will prove more eloquent than words to reveal what has been done to make the place a pleasing habitation for the staff and workers.

The Danish West Indies have now finally passed over into United States keeping, the purchase price having been paid. The islands will henceforward be known as the Virgin Islands of the United States. It is not proposed to make any changes in the present tax laws save that an export tax of $ 8 per ton is to be placed on sugar. All products of the islands are to be granted free entry into the United States.

Air and Incondensible Gases in Effect Evaporators.

By JAS. HAMILL.

As is now pretty well known the presence of air in any of the calandrias of an evaporator reduces the capacity of the apparatus. The main reasons for this reduction of capacity are as follows:—(1) Reduction of temperature of steam; (2) Reduction of transmission coefficient due to lower steam pressure.

Taking (1), the reduced steam temperature is due to the fact that the air pressure forms part of the total pressure in the calandria, and as the total pressure is a fixed quantity, viz., that of the exhaust from the engines or the turbines, the pressure due to the steam is correspondingly reduced, and with it the temperature, since the steam in such cases is always saturated and in the presence of water. The early builders of effect evaporators found that the duty fell off perceptibly after being at work for some time, and the necessity of removing the air from the earlier vessels was soon forced on their attention. Small pipes were therefore fitted with improved results, and for a period thereafter makers vied with each other in fitting incondensible gas pipes of as large a size as possible, a pipe of 4 or 5 in. being used in some cases for quite a moderate size of plant.

Recently, however, practice has moderated considerably, and evaporators have again been constructed without any air connexions, the draining pump being relied upon to remove the air with the condensate, although KERR has pointed out that such a system as usually fitted fails in its object.

It would therefore appear that a clearer perception of the requirements of the case would be of advantage to all concerned. The writer has made a special study of this phase of evaporator work, and whilst the suggestions in what follows are put forward tentatively, it is believed they are fundamentally correct. On the evaporation of sugar juices an unknown amount of ammoniacal and other gases is driven off with the steam, which if allowed to accumulate in the succeeding calandria would gradually reduce the capacity to vanishing point. Further, in all vacuum apparatus an unknown amount of air leaks into the vacuum space and has the same detrimental effect as the other gases. In dealing with the last vessel of an effect, due care is always taken to provide a suitable vacuum pump for the removal of these accumulations of air, but in the earlier vessels where the same conditions hold, the voiding of the air is usually considered sufficient if some air pipes are fitted, the size being left as of lesser moment.

As regards the first vessel calandria the accumulation of air is not generally important as a slight pressure usually exists. If the air be blown out at the start up, no further accumulation will take place if the air cock be opened at intervals.

The air exhaustion from the later vessels should, however, be very carefully considered if the full capacity of the plant is to be obtained. To this end the following methods may be adopted:—

(*a*) A separate air pump for each vessel (as distinct from a drainage pump).

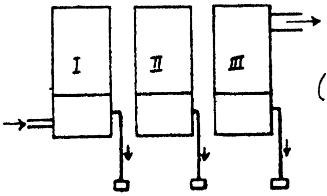
(*b*) A separate air connexion from each vessel direct to the condenser.

(*c*) An air connexion from each calandria to the following vapour space and so to the condenser.

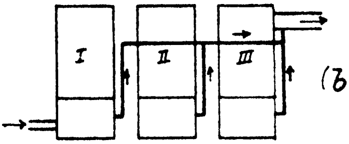
These various arrangements are shown diagrammatically in the sketches *a*, *b*, and *c*.

Considering *Method* (*a*), the amount of air to be removed must be approximately known to enable the correct capacity of the pumps to be estimated, after which the type may be decided, which latter may be of the dry reciprocating type, dry rotary, or wet reciprocating types. If the dry reciprocating be adopted a separate means of removing the condensate will be required. With some forms of dry rotary and with all forms of wet reciprocating pumps the air and water may be removed together, provided the piping is *correctly* designed.

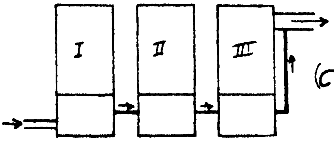
For estimating the volume of the air very precise figures cannot be given, but it may be taken that the weight of air and incondensible gases given off in each cell will be the same, and will amount to about 2 lbs. per 1000 lbs. evaporated per cell. The figure given represents average practice, with standard evaporators built up of cast-iron parts with flanged joints. It might appear that more air would require to be exhausted from the later vessels on account of the higher vacuum existing therein, and while this holds up to about 16 or 17 in. vacuum, the weight of air due to leaks will not increase above that vacuum due to the principle of Napier's law. This has been verified in practice—therefore, whilst more air will leak into a cell at 17 in. vacuum than at 5, the gases given off by the juices in the earlier vessels will be more, and will about counterbalance any reduction in the air.



(a)



(b)



(c)

Using this figure for weight of air to be removed from each calandria, the volume of same may be readily calculated, if the temperature and vacuum at which it leaves the calandria is known or can be safely assumed. The sizes of the various air vent pipes can then be determined by allowing a gas velocity of 200 to 300 ft. per second, depending on the size. The first calandria will not require the pipe proportioned thus, whilst the gases from the vapour space of the last vessel will be dealt with in the condenser and need not be further considered at the moment.

Considering *Method* (*b*), the pipes should be proportioned as in (*a*), and should be fitted with a regulating valve, to ensure that hot steam is not drawn to the condenser. This point will be referred to later.

With *Method* (*c*) the foregoing figures will still hold good, but it will be apparent that much longer pipes will be required from the later cells. Taking a quadruple effect as an example, the vent pipes in the various cells must be proportioned for—

1st Calandria. Air in steam only.

2nd Calandria. Air from first vessel, only at corresponding temperature and pressure.

3rd Calandria. Air from first and second vessels at vacuum and temperature existing in the *latter*.

4th Calandria. Air from first, second, and third vessels at vacuum and temperature in the *latter*.

The vent pipes will therefore be larger than in the methods (*a*) and (*b*) in the proportions of—

1st Calandria, same size.
2nd Calandria, same size.
3rd Calandria, twice as large.
4th Calandria, thrice as large.

This is a common method of arranging the venting, but is seldom properly carried out. The disadvantages are: increased cost of pipes (which must be of copper), and the carrying of the air through the various calandrias, thereby reducing the temperature of the steam and the comparative duty. On the other hand, the method leaves less room for careless operation, as should steam be drawn from the earlier vessels it is condensed in the later cells, the dead loss being steam drawn from the last calandria only. In any case, however, the loss cannot be great, but the results by this method will be generally inferior to those obtained by leading the air from each cell direct to the condenser. In any vessel, in order that the proportion of steam drawn off with the air may be small, the mixture should be at a lower temperature than that corresponding to the vacuum in the calandria. The closer this temperature approaches the steam temperature the less air there will be in the mixture, by Dalton's law, whilst the colder the mixture the richer it will be in air, for it is a fundamental truth that no air can be removed without *some* steam. This cooling of the mixture is usually obtained by closing down the vent valve, and the result is that a quantity of air accumulates in the calandria until the tubes have had some cooling effect, so that whilst economy is maintained the evaporative capacity is reduced by this lowering of temperature in the steam space.

A much better plan is that adopted by surface condenser designers. A few tubes are baffled off near the air outlet, round which the air is made to circulate and reduced in temperature, whilst the remainder of the tubes operate at the temperature corresponding to the vacuum, and therefore at their maximum heat-transmitting capacity. By this arrangement the capacity of about 98 per cent. of the tubes is maintained at the highest point whilst economy is safeguarded by having the vented air sufficiently cooled to ensure that the amount of vapour drawn off is small. In the earlier vessels this will be attained if the temperature the of the mixture is say 5° below the temperature of the steam in calandria, whilst in the later vessels the cooling effect should be 10° to 15° F.

The foregoing figures will be found of great use in proportioning the air pump for the main condenser. The main air pump will have to deal with the air and incondensible gases from *all* the cells if methods (*b*) and (*c*) are utilized, plus the air liberated from the injection water. On the assumption that the same amount of vapour is evaporated from each vessel the amount of air to be dealt with will be for a quadruple effect :—

From 1st vessel 2·0 lbs. per 1000 lbs. steam per hour
,, 2nd ,, 2·0 ,, ,, ,,
,, 3rd ,, 2·0 ,, ,, ,,
,, 4th ,, 2·0 ,, ,, ,,
Total .. 8·0 lbs. per 4000 lbs. steam total evaporation.

Advantage may be taken of the fact, however, that with one large pump this allowance may be reduced, and it will probably be sufficient to base on 6 lbs. of air to 4000 lbs. total evaporation.

Assuming further that the ratio of steam to water in the condenser is 40 to 1, the water required will be 4000 gallons per hour, and if the water contains air in solution at the rate of 3 per cent. by volume, the free air liberated will be 19·2 cub. ft., which equals about 1·5 lbs. per hour. The main air pump would therefore have to deal with 7·5 lbs. air for every 4000 lbs. total evaporation in the apparatus, or 7·5 lbs. air per 1000 lbs. evaporated in last vessel.

In plants where method of venting (*a*) is adopted, it will be found these figures for air from the various cells will give satisfactory auxiliary venting pump sizes, but it would not be wise to use the figure for the last cell in proportioning the main condenser air pump. The figure given is 2·0 + 1·5 = 3·5 lbs. air per 1000 lbs. steam from the last vessel, and whilst this would be quite large enough for ordinary working, it would not leave sufficient reserve for getting up the vacuum at the start. A further 25 per cent. may be required for this purpose.

A further word of warning should be given. These figures do *not* apply to vacuum pans. The working conditions of these are entirely different and must be specially allowed for in the air pump.

Correspondence.

THE MANUFACTURE OF BEET SUGAR IN ENGLAND.

To the Editor, "The International Sugar Journal."

Sir,—Quite lately Sir Richard Winfrey, Parliamentary Secretary to the Board of Agriculture, replying in the House of Commons to Lt.-Col. Page Croft with respect to the Beet Sugar Industry in this country, said: "The uncertainty with regard to this problem is whether sugar beet can be commercially manufactured into sugar at a profit in normal times in this country. Until that is settled it is of no use to divert land from the cultivation of essential crops, or to allow the establishment of factories for the making of beet sugar."

Will you permit me to show that beet sugar can be manufactured in England, not only at a profit, but at a good profit? Sugar beet *is* an essential crop; because sugar is an essential food.

I will not weary readers with a repetition of statistics except to say that, of our whole two million tons of sugar imports before the war, only about one-fifth came from our own cane-growing dependencies. With a small exception in Norfolk, all the rest was continental beet sugar. Shall we again be so insane as to trust to that source? Whatever difficulties stand in the road they must, and can, be overcome.

From the factory point of view the cost of manufacture falls under two main heads: the cost of the raw material, viz., the beets themselves, and the cost of extracting the sugar.

To deal with the latter point first (all figures being on a pre-war basis); the actual working costs of a factory in England, measured over a period of steady, continuous work, were just under 8s. 6d. per ton of beet. This was exclusive of the cost of the beets themselves. With one or two seasons' experience this figure would undoubtedly be reduced, and, I do not doubt, would fall at least by 1s. to 7s. 6d. But let me accept the higher figure for my present purpose

Economy in working greatly depends on a full and continuous supply of beet. Interruption is disastrous, and a small supply of raw material depresses the profit. A factory consuming 800 to 1000 tons of beet per twenty-four hours is of a sound size. But, as it is safest to assume everything on a moderate scale, such as might exist at the commencement of the industry, I will suppose that for a given factory only 3000 acres of beet are grown. Much experience of the cultivation of sugar beet has now been gained in this country, and, whilst many growers have produced from fifteen to twenty tons per acre on experimental plots, I do not think it wise to take a working average over a large area, and in the hands of diverse farmers, of more than ten tons per acre, nett washed weight. Each factory should grow a large area of its own, when fourteen tons per acre might be reasonably expected; but, to effect the greatest national good, outside farmers must also be relied upon, and the bad have to be set against the good.

We thus have a crop of 30,000 tons of beet; a small volume from the economical point of view. The working costs on this would be £12,750.

It has been established as a fact before the war that, properly farmed, a grower could make a handsome profit at 25s. per ton, delivered on rail or barge, or carted a short distance to the factory. Space will not permit me here to enter into details of the farmer's profit; my present business is with the factory.

The factory will, therefore, pay for its beet £37,500. If it pays freight, we may safely set this at not more than an average of 3s. per ton, or another £4500.

As the "campaign," or manufacturing season, lasts only from eight to ten weeks (in this case considerably less) there are necessary "Standing Charges" for the remainder of the year, such as Factory Repairs, Insurance, Marketing of Sugar, Directorate and Clerical Staff, etc. This, on a liberal scale, may on such a crop be put at 4s. per ton of beet; or, for our case in point, say £6000. We thus arrive at a total debit to revenue of £60,750.

To come now to the other side of the sheet.

Beets have been grown in this country with a sugar content of over 20 per cent. From 15 to 18 per cent. has been quite common, but one must look at it from the broad, working point of view, and remember again that the bad grower brings down the average, and that seasons vary. But, working on the diffusion process, and extracting practically all the sugar, there is no reason why we should not count on an average crystallizable sugar content of 14 per cent. In our suppositional factory this gives 4200 tons of sugar.

From our 30,000 tons of beet we should also count on about 600 tons of molasses, and about 2700 tons of beet slices. These latter, wet or dried, form a good cattle food either by themselves or mixed with other materials. Compared with other cattle foods, the intrinsic value of these slices may be taken in normal times at £3 5s. to £3 10s. per ton. To err on the side of moderation I put them at £2 15s. In normal times beet molasses may safely be taken at £2 10s. per ton.

The remaining—and the great—question now is: at what price are we to take our sugar? First, take our total debits and credits, excluding sugar. These are:—

Total cost	£60,750
Less molasses and slices	8,950
	£51,800

This remainder would be exactly balanced by a sale price of 12s. 4d. per cwt. for our sugar—remember, refined sugar.

In such a case, therefore, as I have been citing 12s. 4d. per cwt. must be the minimum price of refined sugar, ex factory to just enable receipts to meet expenses without taking any account of excise or interest on capital.

The capital necessary for the erection and equipment of such a factory, in normal times, should be about £120,000. For working capital £30,000 would suffice, making £150,000 in all.

Assuming that 10 per cent. has to be earned on this, a further £15,000 has to be produced from sugar. That means another 3s. 7d. per cwt. on the price. On the basis of a 30,000 ton crop, then, we get the figure of 15s. 11d. per cwt. as representing the price ex factory, without considering the question of excise duty. This is equivalent to less than 1¾d. per lb.

It would be only wise for the first few years, especially if only one or two isolated factories as yet existed, to impose no excise duty on home-grown sugar, but, as I wish to represent working conditions we will suppose that British sugar has to face a duty of, say, 2s. 6d. per cwt. This practically equals ¼d. per lb.; and brings our price, ex factory, to 18s. 5d. per cwt.; or a little under 2d. per lb.

But, now, suppose that instead of a 30,000, we had to deal with a 60,000 ton crop for our factory. This greater amount would be quite a comfortable figure for such a factory as this. Suppose we establish the figure of 18s. 5d. ex factory; then, on the foregoing basis—working costs being now less per ton—we would realize a profit of £23,700, after paying excise; or 15¾ per cent. on the capital.

Again, take another side of the matter, and for safety's sake assume that, owing to a possible increase in prices after the war, the factory cost an additional £20,000, and that the working costs were 20 per cent. higher than at pre-war rates. Under these adverse influences, taking sugar at 18s. 5d. per cwt.; excise at 2s. 6d. per cwt.; and a 60,000 ton crop of beet, the profit on our capital of, now, £170,000 would be over 10⅓ per cent.

Correspondence.

The foregoing figures are based on what I have actually seen of the difficulties of initiating the industry into this country, and what I consider it is only commercially sane that the business should lay itself out to face at the commencement. I have no sympathy with those who mislead the public with figures that will only be attainable after some experience. You must therefore construe my figures as affording a liberal margin to cover the faults and hesitations of a new enterprise. A few seasons' experience will work great reductions in costs. My object is to show that, and how, sugar would pay even under initial difficulties. I also assume what I know to be an absolute necessity: a fair price to the farmer for his beets. Time will show the farmer that he can make beet cultivation pay at less than 25s. per ton, nett washed weight; but I am quite certain he will not cultivate on a large scale, at the beginning, under that figure.

My results are taken from actual English experience. To compare them with those of a German factory, as cited by Mr. MARTINEAU in "Sugar," I would point out that the latter takes 6 tons of beet to produce 1 ton of sugar. This means a sugar content for the beets of 16·6 per cent. I content myself with the more modest content of 14 per cent., which I have good reason to feel sure would be an attainable average in this country Martineau's year was an exceptionally good one. My 14 per cent. means 7·14 tons of beet to 1 ton of sugar. Had MARTINEAU taken 14 per cent. of sugar, his sugar would have come out at 10s. 2d. per cwt. (remember, *un*refined); and had he taken his beets at 25s., his sugar would then have cost 11s. 7d. per cwt.

It is extremely uncertain what charges he exactly includes against his cost: it is not apparent that he includes standing charges throughout the period of the year other than the "campaign" period. On the other hand, I deal entirely with refined sugar, and give a total annual cost—everything included—of £60,750 for only a 30,000 ton crop. This, at 14 per cent. sugar content, gives 14s. 5d. per cwt. for my sugar—*refined*, without allowing for residual molasses and slices at all. If these are taken in, my sugar then comes back to the 12s. 4d. as compared with Martineau's 11s. 7d.; and if I exclude the ex-campaign charges and freight, my total is £50,250, which, at 14 per cent. content, gives 9s. 8d. for my refined sugar.

Going back to the 11s. 7d. per cwt. mentioned before as the equivalent of Martineau's sugar at 14 per cent. and 25s. for beets, then a further 2s. per cwt. may at least be fairly added to this to equal refined sugar. We thus get 13s. 7d. per cwt. as against my 14s. 5d. or 12s. 4d. after sales of molasses and slices, which, I think, is not a bad comparison with the German working costs. You will thus see that the main point of difference between my figures and the German ones cited by Mr. MARTINEAU lies in the fact that I take my beets at 25s., whilst he takes his at 21s.; and I take a realizable sugar content of 14 per cent., whilst he takes 16·6 per cent.

I have also assumed an increase of 20 per cent. on the working costs after the war—probably quite an excessive increase, and an increase in cost of machinery and construction materials of £20,000. This I do so as to show the *worst* aspect that is likely to arise in the initiation of the industry, and that, even under these circumstances, the cultivation of sugar beet, and the manufacture of beet sugar, would pay a dividend of quite 10 per cent., provided two things: that a full supply of beet was forthcoming to enable each factory to work economically, and that sugar was not sold in this country under 2d. per lb. refined, ex-factory. I maintain that it falls to the duty of the Government to ensure that both these conditions are assured, and I believe if the public understood the position, they would insist on such conditions being brought about. Through the Board of Agriculture and the Ministry of Labour they should so arrange with farmers that the necessary acreage of beet is grown; that the requisite labour, in the proper season, is supplied; and that the farmers are scientifically instructed in the cultivation of sugar beet. In the upkeep of our navy we ungrudgingly pay an insurance on the safety of our shores and commerce. Should we not, through Government activity, ensure our sugar supply for all time, even if it costs 2d. per lb. at the factory? It should surely be retailed at 2½d.

H. F. EASTON.

CONDENSING SYSTEMS.

To the Editor, "The International Sugar Journal."

Sir,—I cannot agree with Mr. Coxon's reasoning upon the behaviour of gases in condensing plants, and neither can I understand what assistance he obtains from the article, "Air in Condensers." This article does *not* employ anything *but* Charles' law, and if Mr. Coxon refers to the January number of the *I.S.J* he will see his error.

I believe many readers besides myself would be grateful to Mr. Coxon if he would show his method of finding the volume in question by the combination suggested by him. For "practical" uses Boyles' law is certainly not good enough A difference by volume approaching 10 per cent. shows itself upon the wrong side by such methods.

With 40,000 lbs. of vapour per hour, and the incondensible mixture reaching the pump at 90°F., the error would be about

$$= \frac{40,000 \times 7 \times 10 \times 800}{1000 \times 100}$$

$$= 22,400 \text{ cub. ft. per hour.}$$

How Mr. Coxon would deal with this surplus is difficult to conceive.

Yours sincerely,

Gavin Alston Renton.

To the Editor, "The International Sugar Journal."

Sir,—In your February issue, Messrs. Coxon and Hamill seek for further details than were given in my paper on the use of injection water for central condensers.[1] In reply I will answer with pleasure the questions put by them as far as is possible.

The type of condenser referred to in my paper is the cataract barometric condenser. The lower part, 2000 mm in diam. × 1150 mm. high, receives the vapours, while the upper part, 1500 mm. in diam. × 4660 mm. high, contains a spiral staircase built up of iron steps. The injection water entering at the top travels down this staircase, meeting *en route* the vapours which ascend from below.

Unfortunately, I cannot give any barometric readings. The following data show that the low vacuum was chronic :—

Date. 1916-17	Effect	Vacuum Pans
1 November	580	670
12 ,,	615	670
13 ,,	620	650
20 ,,	610	610
22 ,,	0 (cleaning)	620
23 ,,	610	690
24 ,,	600	640
26 ,,	610	600
30 ,,	260 (lack of water)	580
1 December	600	650
10 ,,	620	670
Average reading IV pan	580	

1915-16	Effect	Vacuum Pans
Uniform	650	650
Average reading IV pan	620	

The following readings I recorded from the fall-water, taken by means of a vacuum flask :—

Date.	Effect	Vacuum Pans	Injection Water.
31 October	39° C.	—	—
3 November	30° C.	33° C.	10·5° C.
30 ,,	37° C.	22° C.	—
13 December	24° C.	20° C.	5° C.

The quantities of injection water on this last date I figured for the effect condenser at 506 per cent. of beets, say, 500 per cent., and for the vacuum pans condenser at 573 per cent. beets, say, 600 per cent., making a total of 1100 per cent. beets, thus showing that there was no lack of water.

---

[1] *I.S.J.*, 1916, 551.

Mr. Hamill suggests air leaks as the cause of the deficit in vacuum. The chance that these existed is very small, as the installation was thoroughly tested before starting up. Mr. Hamill's idea, that the work on the air pump is unaffected, is shared by many other sugar engineers, but actual practice should decide this question, and for the coming campaign we shall have the condensers draw their water again from the tank above. I will take care this time to note the readings, and in due course will give them to the readers of your journal.

Yours faithfully,
Ed. Koppeschaar

Publications Received.[1]

The Mauritius Almanac. Compiled by A. Walter, F.R.A.S. Forty-eighth year of publication. (R. de Spéville & Co., Mauritius.) 1916.

This work of reference, compiled by the Census Commissioner for Mauritius, gives very complete information relating to that Colony, its political constitution, places of interest, industry, commerce, and agriculture, as well as statistical data of its finances, imports and exports, shipping, meteorology, and the like. It is recognized as an authoritative handbook invaluable to all interested in Mauritius.

The Overseer and Sugar Factory Control. Issued by Messrs. Geo. Fletcher & Co., Ltd., Masson and Atlas Works, Derby, England Crown 8vo.; 25 pp. Gratis.

This booklet, which has been prepared by a well known firm of sugar machinery manufacturers in this country, is intended to serve as a guide to the overseers of such sugar factories as are not of sufficient size to be able to afford the services of a trained chemist, but which nevertheless will benefit by their supervisors possessing some inner knowledge of the character of the manufacture and some ability to locate sources of loss. To such factories the simple directions offered in this brochure apply. The essential items of control dealt with are the specific gravity determination, the polarization, and the estimation of glucose in juices and syrups. A few useful tables are included at the end. We need only add that Messrs. Geo. Fletcher & Co. Ltd., will be glad to send a copy to anyone interested who takes the trouble to apply for it.

From Sugar Cane to Sugar Bowl. Warner Sugar Refining Co., 79, Wall Street, New York. Paper Covers, 48 pp.; Royal 8vo. Gratis.

This is a finely illustrated representation of the processes covered in the refining of sugar, as practised by this well known American refining company, and while written in popular style to appeal to the larger circle of sugar consumers cannot fail to interest also those who are engaged in the process of manufacturing raw sugar. Practically every stage of the refining process is depicted, the illustrations of machinery being of unusually clear definition.

The Sugar Manufacturers' Supply Co., of 2, St. Dunstan's Hill, London, E.C.3, has been registered as a private limited liability company, the capital being £10,000 in £1 shares, and the objects "to carry on the business of J. P. Ogilvie, trading as The Sugar Manufacturers' Supply Co., as General Merchants, Brokers, Agents, Manufacturers, etc."

---

[1] Books and other Publications marked with an asterisk (*) can be ordered if desired through Norman Rodger, 2, St Dunstan's Hill, London, E C 3 Those not so indicated should preferably be ordered direct, especially pamphlets to which no price is attached, as these are in many instances gratis. Postage as a rule is extra

Review of Current Technical Literature.[1]

NEW METHOD OF UTILIZING MOLASSES FOR MANURE. *J. W. Reed. The Australian Sugar Journal, 1916, December 7th;* and private communications to *The International Sugar Journal.*

As is known, molasses at present finds its main utilization for the manufacture of alcohol, and a little is disposed of for fodder purposes, whilst efforts to use molasses as a fuel have, in the main, been both crude and wasteful. Though the ash content of molasses has always been recognized as valuable for manurial purposes on account of the large percentage of potash, yet the disadvantages attending the application of molasses to the soil are altogether against its use as such in that way. According, however, to a patent recently taken out by Dr. REED, of Cairns, North Queensland, molasses can be cheaply treated so as to largely reduce its weight and character, hence concentrating the valuable manurial ash content, and at the same time destroying its fermentable sugars, converting these into humus-like bodies of undoubted manurial value and beneficial to the physical qualities of probably all soils.

This treatment, it appears, consists in evaporating and partially or fully carbonizing the molasses. If, for example, the process be carried only to the stage of the destruction of sugar, the potash content if an average molasses be used will be about 7 per cent., equal practically to 14 per cent. of commercial sulphate of potash. If, however, it be taken to the full stage of carbonization, the potash content will be about 20 per cent., equal practically to 40 per cent. of commercial sulphate. If again it be pushed to the final stage, the percentage of potash will represent approximately that of commercial sulphate.

It is claimed as not improbable that the potash held in the humus-like matrix of material produced by carbonization to stages 1 and 2 may be more valuable than the equivalent potash of commercial sulphate, owing to the slower availability and lesser likelihood to loss by drainage waters. It further seems a safe assumption that the other mineral constituents have some minor value; while there can be little doubt that the humus-like or carbon matrix of the treated molasses must be very beneficial to practically all soils. As the products of stages 1 and 2 are easily crushed into powder, they can be bagged for transport or storage; and can be used on the field either alone or mixed with other fertilizers, being spread either by hand or by a mechanical distributor.

DETERMINATION OF REDUCING SUGARS BY LEHMANN'S METHOD. *L. Grimbert. Annales de Chimie analytique;* through *Bulletin de la Société des Chimistes de Maurice, 1916, 7, No. 4, 152-154.*

Lehmann's process for the determination of glucose has been the subject of numerous communications. But in spite of its simplicity it is at present seldom in use, certain sources of error rendering it unreliable, even after the modifications introduced by Maquenne.[2] However, it is now claimed by the writer that he has been able so to elaborate it as to an accuracy comparable with the classical procedure of Bertrand.

It will be remembered that it consists in estimating the excess of copper remaining after the reducing action of the sugar by adding a solution of potassium iodide, iodine being liberated, the action involved proceeding as follows:— $2\,CuSO_4 + 4\,KI = Cu_2I_2 + 2\,K_2SO_4 + 2\,I$; one atom of copper liberating an atom of iodine.

---

[1] This Review is copyright, and no part of it may be reproduced without permission.—(Editor, *I.S.J.*)

[2] *I.S.J.*, 1916, 523.

Now all the investigators who have concerned themselves with this process have titrated the iodine liberated by means of a standard solution of sodium hyposulphite, although the end-point is difficult to detect in a liquid which holds cuprous iodide in suspension and which always has a tendency to decolorize. Moreover all these authors—Lehmann, Riegler, Garnier, Maquenne, and others, do not appear to have adopted a uniform period of boiling together the Fehling's and the sugar solutions, the result of which two failings is that the process lacks precision. But matters are otherwise if one operates with a sufficiently dilute solution when titrating; if one adds an excess of sodium hyposulphite, this excess being ascertained by means of iodine in the presence of starch; and also if in the early part of the determination when reducing the cupro-potassic liquor with the sugar solution one adheres strictly to the conditions regarding composition of reagents and time of boiling stipulated by Bertrand. Identical results may then be obtained with those found by this writer's method, so that in fact the tables of cupric reducing values published by him[1] may be used.

In commencing the determination, the titre in copper of the Fehling's solution (Bertrand's formula) is once for all ascertained. In so doing 20 c.c. of the blue and 20 c.c. of the white liquors are introduced into a graduated 200 c.c. flask, the volume of which is completed to the mark. Into a beaker, 50 c.c of this diluted solution, 8 c.c. of sulphuric acid (1 : 1), and 10 c.c. of potassium iodide solution (20 per cent.) are placed, and after a few minutes 10 c.c. of N/10 sodium hyposulphite solution are run in, the excess of which is titrated by means of N/10 iodine solution, using starch as indicator. If n be the number of c.c. of iodine solution required, the quantity of copper contained in 20 c.c. of the blue liquor of the Fehling's solution will be as follows: $(10 - n) \times 0{\cdot}00635 \times 4$. When actually carrying out that portion of the determination concerning the reduction, Bertrand's procedure is strictly followed: Into a conical flask, 20 c.c. of the blue and 20 c.c. of the white liquors together with a volume of the sugar solution containing less than 100 mgrms. of reducing sugars are placed, water being added if necessary to make up to 60 c.c. This is heated, and boiling is maintained for just three minutes. The reduced liquid is washed with boiled water into a 200 c.c. flask, which is filled to the mark, cooled with a jet of water for five minutes, the volume adjusted to the 200 c.c. mark, and the liquid filtered, 50 c.c. of which are treated in the manner already described. The difference between the two determinations will give the quantity of copper reduced by the sugar solution, and by referring to Bertrand's table the actual quantity of sugar is thus found. Here, by way of example, are figures showing the copper reduced (the result of two operations) using a solution of pure anhydrous glucose, the $[\alpha]_D$ of which was + 52·79.

	Copper Reduced.	
Glucose, mgrms.	Found by the New Method, mgrms.	According to Bertrand's Tables, mgrms.
10	20·59	20·4
20	40·64	40·1
30	59·60	59·1
40	77·47	77·50
50	94·25	95·40
60	112·76	112·80

J. P. O.

In Russia an Imperial decree has been published suspending during the period of the war the prohibitions and restrictions regarding saccharine enjoined by existing laws and regulations. The Department of Public Health is drawing up legislation for trading in this commodity, and its manufacture in unauthorized establishments is prohibited.

---

[1] *Bulletin de la Société Chimique*, 1906, 35, 1285.

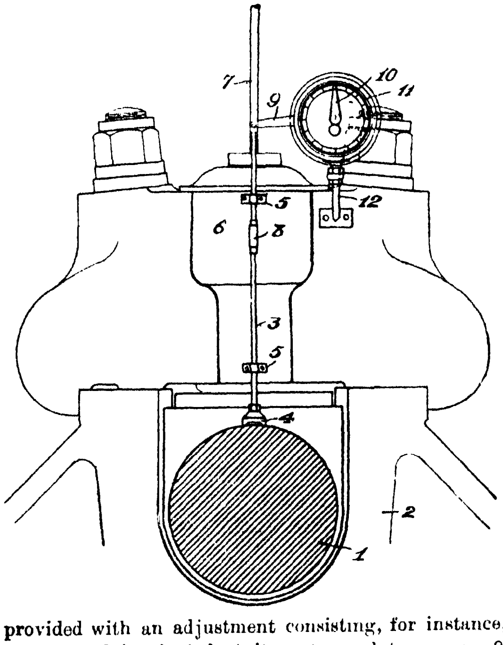
Review of Recent Patents.[1]

UNITED KINGDOM.

INDICATING DEVICE FOR THE ROLLERS OF CANE MILLS. *James Miller*, of 18, Buller Street, Derby; and *George Fletcher & Co., Ltd.*, of Masson and Atlas Works, Litchurch, Derby. *103,972* (*14,929* of *1916*). October 20th, 1916.

This invention relates to indicating devices for the rollers of crushing or like mills, where the movement of the roller is communicated to a pointer by means of a series of links connected at one end to the pointer, and at the other end bearing on the roller or its bearing-bush, or connected to this latter. It concerns a simplified mechanism whereby extraordinary motion is possible to the roller without causing a straining or a breakage of the indicating apparatus.

Particularly in cane crushing mills is it desirable to have an indicating mechanism on the roller, preferably one at each end; and yet, as is known, often the roller lifts to a degree much beyond its normal limits of rise or fall to clear an obstruction which may accidentally have been fed to the crushing mill with the cane. The present invention therefore comprises a rod moving with the roller or its bearing-bush and connected to the pointer of an indicator so that both rod, pointer, and linkage or means interconnecting these parts are capable of motion considerably in excess of the maximum indicated by the scale co-operating with the pointer.



As is shown in the illustration, the roller *1* of a sugar cane mill is supported in a headstock *2* in normal manner, and a rod *3* by means of a foot *4* rests on the roll *1*, so that any vertical movement of the roll relatively to the headstock *2* causes the rod *3* to move vertically in its bearings *5*. It is obvious that the rod *3* may bear on the bush against which the roller shaft *1* bears instead of directly on this latter. The movement of the roller *1* is controlled by hydraulic pressure communicated to the cap *6* through hydraulic pipe connexions *7* in normal manner. The rod *3* is provided with an adjustment consisting, for instance, of a right and left-hand threaded nut *8*, and is pivoted at its outer end to an arm *9*, the other end of which is geared through suitable mechanism to the pinion on the spindle of a pointer *10*. This pointer *10* is capable of movement without limit over a fixed graduated circular dial *11* mounted on a support *12* on the headstock *2*.

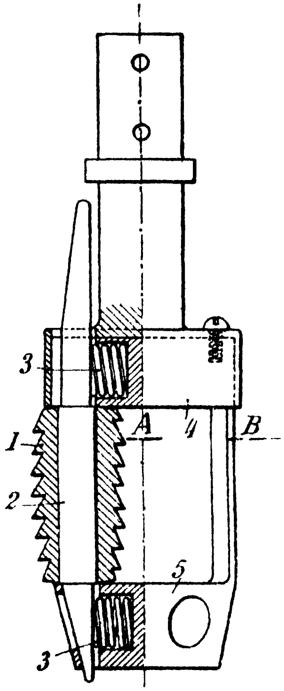
The arrangement indicated above is preferably designed so that the slightest movement of either end of the roller is recorded by a large movement of the gauge or indicator pointer. With both gauges or indicating devices placed so that the engineer-in-charge can read the dials of the recorders from, say, a cross gangway on the mills, then for normal working, the loads of the accumulators can be so adjusted that the pointers on both gauges will show the same movement, thus indicating that the roller is perfectly balanced against the thrust of the pinion.

---

[1] Copies of specifications of patents with their drawings can be obtained on application to the following.—*United Kingdom:* Comptroller of the Patent Office, Southampton Buildings, Chancery Lane, London, W.C. (price, 6d each) *United States:* Commissioner of Patents, Washington, D.C. (price 5 cents each). *France:* L'Imprimerie Nationale, 87, rue Vieille du Temple, Paris (price, 1 fr. 05 c. each) The date given in the heading of United Kingdom specifications is that of the application of the patent.

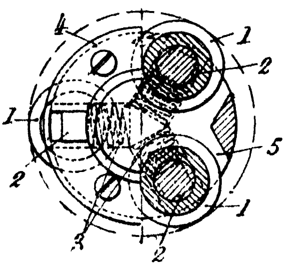
- - -

APPARATUS FOR THE REMOVAL OF SCALE FROM BOILER AND OTHER TUBES. ***Compagnie Générale de Détartrage des Chaudières et Conduites d'Eau,*** of 28, rue de Lyon, Algiers, Algeria. *102,259 (16,034* of *1916).* November 8th, 1916. Under International Convention, November 13th, 1915, France.



In order to remove scale from boiler and other tubes, a rotary scraper of suitably smaller diameter than that of the tube to be cleaned has been devised, a spring or springs holding the scraper in contact with the inside of the tube, and V-shaped, annular or helicoidal teeth on the scraper formed with one face normal to the axis of the scraper and the other inclined thereto being also provided.

In the illustrations, *1* are scrapers mounted loose on spindles *2* pressed outwardly into engagement with the tube by springs *3* which are suitably compressed and arranged in discs *4* and *5* of the scraper carrier. It will be clear that if a movement of rotation is imparted to the apparatus when introduced into the interior of the tube to be cleaned, it will result in a rotation in the opposite direction of the scrapers *1*, owing to their close contact with the tube under the thrust of the springs *3*. The result of the movement of rotation of the scrapers *1* and the shape of the cross-section of their helicoidal grooves, combined with a reciprocating movement which is preferably imparted to the apparatus, is that the slightly adhesive deposit on the tube is scraped off and pushed outwards, this expulsion being preferably facilitated by a jet of water introduced through the end of the tube, opposite to that of the escape of the deposit.



As will be readily seen on examining the details of the drawing, the cross-section of the helicoidal thread on the scrapers is triangular, one of the sides of the thread being perpendicular to the axis of rotation of the scraper, whilst the other has an inclination obviously varying with the kind of deposit to be removed. In this way, the thread forms a cutting edge, which by grinding against the wall of the tube keeps the edge sharp until it is completely worn away. The wall of the thread, normal to the axis of the scraper, drives the detached deposit in front of it. The scrapers *1* can be made of several superimposed discs or in a single piece. The grooves can even be annular, and if they are helicoidal, they can be right-handed or left-handed according to the direction of rotation of the apparatus. The arrangement of the spindles *2* and the springs can be varied to suit the tubes to be cleaned. For instance the tubes may be either straight or bent or of small or large diameter.

Notes and Comments.

UNITED STATES.

Starch Product for Use in the Fermentation Industries. *Philip Dreesbach.* (Assignor to *The Corn Products Refining Co.*, of New York, U.S.A.). *1,186,893.* Patented, June 13th, 1916.

In order to agglutinate starch powder into a product that can be transported by conveyors without loss of material or the formation of dust, it is mixed with a suitable binding agent as commercial glucose, dextrin, or cane sugar liquor and desiccated, the resulting cake being then broken up into lumps of suitable size. The material thus produced is dustless and relatively hard, but breaks down at the usual mashing temperature to form a starch milk leaving no residue.

Starch Produced for Use in the Fermentation Industries. *Philip Dreesbach.* (Assignor to *The Corn Products Refining Co.* of New York, U.S.A.). *1,186,894.* Patented, June 13th, 1916.

In order to produce a starch product in the form of fragments to replace corn grits and meal and rice, but free from albumen and oil, starch powder is bound together with commercial glucose, dextrin, or cane sugar liquor, heat being applied. The cakes or blocks thus formed are broken up into fragments of a suitable size, such that they will not cause dust in handling. The material produced in this way will break down in water at mashing temperature, forming starch milk leaving no residue.

Utilization of Waste Waters produced in Starch Manufacture. *William N. Sage,* of Keokuk, Iowa, U S.A. *1,187,392.* Patented, June 13th, 1916.

In the manufacture of starch from corn and other raw materials, waste waters containing nitrogenous matter, dextrose and dextrins, phosphates, and potash and lime, are produced. It is proposed to reclaim these by mixing the water with lime, agitating the mixture to prevent settling, drawing it off into a settling tank, and then passing it through a filter-press. After drying the cake in a suitable oven, it is available for use as a fertilizer or for other purposes, as may be determined.

UNITED KINGDOM APPLICATIONS.

Apparatus for burning Solidified Spirit Fuel. *A. de Swiecinski. 10,351.* July 22nd, 1916.

Heating Boiler Feed Water. *D. B. Morison. 10,958.* August 3rd, 1916.

Supporting Casings of Non-conducting Coverings on Boilers, Steam-pipes, etc. *W. P. Wrightson. 11,041.* August 4th, 1916.

Trash Turners for Mills. *G. Fletcher & Co., Ltd., and J. Miller. 11,074* August 5th, 1916.

Cane Mills. *G. Fletcher & Co., Ltd , and J. Miller. 11,075.* August 5th, 1916.

Cane Mills. *G. Fletcher & Co., Ltd., and J. Miller. 11,167.* August 8th, 1916.

Purification of Water to prevent Incrustation in Boilers. *E. Makin. 11,233.* August 9th, 1916.

Graduating, Figuring, and Lettering Laboratory Glassware. *J. James and James & Co. 11,376.* August 11th, 1916.

Evaporator. *F. Brearley, R. Diver, and L. de Pontchalon. 11,407.* August 12th, 1916.

Decolorizing Carbon *A. Macdonald. 11,592.* August 16th, 1916.

Rakes of Beetroot Topping Machines. *Landrain Frères and J. H. Jack. 12,051.* August 22nd, 1916.

Sugar Crops of the World.

(Willett & Gray's Estimates of Cane Crops to March 23rd, 1917)

	Harvesting Period.	1916-17. Tons	1915-16. Tons.	1914-15. Tons.
United States—Louisiana	Oct.-Jan.	273,000	122,768	216,696
Texas	,, ,,	6,250	1,000	3,500
Porto Rico	Jan.-June	400,000	431,335	308,178
Hawaiian Islands	Nov.-July	575,000	529,895	577,186
West Indies—St. Croix	Jan.-June	12,000	14,750	4,500
Cuba, *crop*	Dec.-June	3,000,000	3,007,915	2,592,667
British West Indies—Trinidad	Jan.-June	65,000	64,231	58,822
Barbados, *exports*	,, ,,	65,000	65,000	32,578
Jamaica ,,	,, ,,	15,000	15,143	15,063
Other British West Indies	,, ,,	30,000	30,000	24,000
French West Indies—Martinique, *exports*	Jan.-July	40,000	39,925	38,581
Guadeloupe	,, ,,	40,000	34,111	39,617
San Domingo, *exports*	Jan.-June	150,000	126,058	108,267
Mexico, *crop*	Dec.-June	50,000	65,000	110,000
Central America	Jan.-June	35,000	35,000	36,275
South America—				
Demerara, *exports*	Oct.-Dec. and May-June	120,000	116,224	113,632
Surinam, *crop*	Oct. Jan.	15,000	13,000	12,000
Venezuela	Oct.-Dec.	20,000	7,000	3,000
Ecuador	Oct.-Feb.	8,000	7,567	7,107
Peru	Oct.-Feb.	250,000	250,000	262,841
Argentine	June-Oct.	100,000	152,301	335,833
Brazil, ,,	Oct.-Feb.	225,000	194,000	240,000
Total in America		5,494,250	5,322,223	5,140,343
Asia—Brit. India, *crop* (consumed locally)	Dec.-May	2,400,000	2,636,875	2,460,573
Java, *exports*	May-Nov.	1,596,174	1,198,567	1,303,045
Formosa and Japan, *crops*	Nov.-June	430,000	391,549	262,000
Philippine Islands, *exports*	,, ,,	170,000	316,450	243,000
Total in Asia		4,596,174	4,543,441	4,268,618
Australia	June-Nov.	175,000	150,000	246,408
Fiji Islands, *exports*	,, ,,	100,000	90,000	102,000
Total in Australia and Polynesia		275,000	240,000	348,408
Africa—Egypt, *crop* (consumed locally)	Jan.-June	100,000	100,000	75,738
Mauritius, *crop*	Aug.-Jan.	220,000	215,528	277,164
Réunion, *exports*	,, ,,	45,000	45,000	39,267
Natal, *crop*	May-Oct.	125,000	112,000	91,619
Mozambique, *crop*	,, ,,	55,000	50,000	40,000
Total in Africa		545,000	522,528	523,788
Europe—Spain	Dec.-June	6,000	6,359	7,376
Total cane sugar crops		10,916,424	10,634,551	10,288,533
Europe—				
Beet sugar crops	Sept.-Jan.	4,819,000	5,077,760	7,583,215
United States—				
Beet sugar crops	July-Jan.	775,000	779,756	646,257
Canada—				
Beet sugar crop	Oct.-Dec.	14,000	17,641	13,979
Grand total cane and beet sugar	**Tons**	**16,524,424**	**16,509,708**	**18,531,984**
Estimated increase in the world's production	,,	14,716	....	....

United States.

(Willett & Gray, &c.)

(Tons of 2,240 lbs.)	1917. Tons.	1916. Tons.
Total Receipts January 1st to March 29th	780,573	746,174
Receipts of Refined ,, ,,	—	—
Deliveries ,, ,,	761,939	746,125
Importers' Stocks, March 28th	29,599	4,127
Total Stocks, March 28th	303,883	106,433
Stocks in Cuba, March 28th	408,631	693,326
	1916	1915.
Total Consumption for twelve months	3,658,607	3,801,531

Cuba.

STATEMENT OF TOTAL EXPORTS AND STOCKS OF SUGAR, 1914-1915, 1915-1916, AND 1916-1917.

(Tons of 2,240 lbs.)	1914-15 Tons	1915 16. Tons.	1916-17 Tons.
Exports	181,326	302,205	207,913
Stocks	123,702	212,527	186,665
	305,028	514,732	394,578
Local Consumption	7,820	8,200	9,700
Receipts at Ports to January 31st, 1917	312,848	522,932	404,278

Havana, January 31st, 1917 *

J. GUMA.—L. MEJER.

* No later statement to hand on going to press.

The European Beet Crop.

(After Willett & Gray.)

	1916-17. Tons	1915-16. Tons.
Germany	1,500,000	1,400,000
Austria	945,000	1,011,400
France	200,000	135,899
Belgium	100,000	113,097
Holland	260,000	242,753
	3,005,000	2,903,149
Russia	1,250,000	1,467,096
Sweden	150,000	127,315
Denmark	120,000	125,200
Italy	150,000	230,000
Spain	110,000	160,000
Switzerland	4,000	4,000
Rumania	15,000	31,000
Bulgaria	15,000	22,000
England	....	8,000
	564,000	707,515
Total for Europe	4,819,000	5,077,760

[*** *Owing to delay in the issue of the Board of Trade figures for March, we are unable to give this month the usual tables relating to the Imports and Exports and Consumption of Sugar in the United Kingdom.*]

THE

INTERNATIONAL

SUGAR JOURNAL.

No. 221. MAY, 1917. Vol. XIX

☞ All communications to be addressed to "The International Sugar Journal," 2, St. Dunstan's Hill, London, E.C.

Cheques and Postal Orders to be made payable to "The INTERNATIONAL SUGAR JOURNAL," and not to individuals.

☞ The Editors are not responsible for statements or opinions contained in articles which are signed, or the source of which is named.

The Editors will be glad to consider any MSS. sent to them for insertion in this Journal and will endeavour to return the same if unsuitable; but they cannot undertake to be responsible for them unless a stamped addressed envelope is enclosed.

Notes and Comments.

America's Decision.

On the 6th April Congress gave President WILSON an overwhelming vote to break with past traditions and involve the United States in the settlement of European affairs. This enabled the President to follow up the breaking-off of diplomatic relations with Germany by a direct declaration of war, and thenceforward we are able to number the biggest American Republic amongst the Allies. It is a welcome addition, for, apart from its almost certain effect on the duration of the war, it strengthens the chances that a decisive outcome may be obtained, such as will leave no loophole for a repetition of the present carnage at some future date.

Whatever Germany may say about it, there is no manner of doubt that America's decision is actuated by no mean or selfish motives. She has come to realize surely if slowly that, as the Allies have all along contended, this Gargantuan struggle for victory in Europe has such world-wide principles at stake—principles of freedom and honour—that she, who has always been such an exponent of national freedom, could not indefinitely hold herself aloof if she was not to go down to posterity as a nation which dared not live up to its principles. There has always been a large body of well-informed opinion in the States which recognized from the first that we were fighting for such principles, but undoubtedly the majority of the citizens of the United States, being far removed from the scenes of strife, were only slowly converted to this view and failed to realize that we were fighting their battles as well as our own. Till he could carry the whole country with him, the President seemingly felt that his hands were tied, and he consequently exhibited a degree of caution and patience in his dealings with Germany which necessarily led to some misunderstanding of his motives and intentions. Whether he could have come into the fray sooner than he did, it is perhaps unnecessary now to argue; the chief thing is that Dr. WILSON has at length ranged himself and his country on the side of those nations who are fighting to liberate a large number of small nationalities from the tyranny of a military caste who, in pursuit of their ideals of "world might," are unscrupulous and unprincipled to a degree that would have been thought inconceivable a few years ago. And in taking this step America has nothing to gain but a share in the future security of the world to go about its peaceful vocations. Her trade will suffer as ours has done, her manhood will be bled, and her whole course of prosperous existence will receive a more or less severe check. But having once made up their mind that the goal is worth gaining, the American nation are promptly showing us that they intend to do nothing by halves; it is clear they are going to enter very thoroughly on their task, and leave no stone unturned to crush the régime of what a member of their community not inaptly termed the "road hogs" of Europe. For the sake, especially, of all those peoples who are suffering acutely from this régime, who are being starved and illtreated or done to death, we sincerely hope that this latest intervention may bring speedy relief and shorten the days of their tribulation.

Imperial Preference accepted.

One distinction that differentiates the present British Government from nearly all of its predecessors is its readiness to accept the conclusions of representative committees or commissions appointed from time to time to investigate a policy or a need. In the old days these boards of enquiry, after publishing voluminous blue-books of evidence and issuing weighty and sometimes very pertinent reports, more often than not found their work pigeonholed and ignored by the Government of the time being, because it did not suit the latter's political creed or opportunity to follow up the report by action. But although most of the committees whose reports have lately been issued were appointed by the previous composite Government, their conclusions come to are nevertheless receiving the full consideration of the present Government and are on the whole being acted on to a commendable extent.

We have had the Balfour of Burleigh Committee on Imperial Preference[1] and the Sub-Committee on Agricultural Policy.[2] Both these have been followed by Government action. The second has led to the introduction of a Bill to guarantee prices for cereals to the home farmer for a term of years, as well as a minimum wage for his labourer. As regards the former committee, the Imperial War Cabinet, consisting not only of members of the Government but also of all the Colonial Governments except Australia (whose representative has unfortunately been delayed by political troubles in that Commonwealth), has debated the subject and has unanimously accepted the principle that "each part of the Empire, having due regard to the interests of our Allies, shall give specially favourable treatment and facilities to the produce and manufactures of other parts of the Empire." There is, it is added, no intention whatever of making any change during the war. That is a natural corollary; but it is not very material whether we start now or a very few years hence. The great thing is that the principle is conceded, and steps will doubtless be at once taken to start formulating at leisure a workable scheme which can be put into force once peace is restored and the road is clear.

The Premier's View.

We cannot do better than quote Mr. LLOYD GEORGE on this subject, as showing what the mind of the Government is. In the course of a great speech made on the occasion of the presentation to him of the Freedom of the City of London on April 27th, he said[3]: "We have been taught by the war the real value of the Empire as a world-force, and one of the first duties of statesmanship in the future will be to take all measures that are necessary to aid in the development of the stupendous resources of the Empire. That ought to be our special care, our special pride, as it undoubtedly would be our special security. We want to develop the land under the flag. If fifty years ago we had directed our minds and our power and our influence to that end, you would now have had double the population you have got in these Dominions, by diverting the tide of emigration to British Dominions instead of other lands, and you would have attracted the virile populations of Europe in addition to that.

---

[1] See *I.S J.*, 1917, 102 and 110 [2] Ibid, 1917, 149 and 155 [3] Vide *Times* report

"In the future we have decided that it is the business of Statesmanship in Great Britain, as well as in the lands beyond the seas, to knit the Empire in closer bonds together of interest, of trade, of commerce, of business, and of general intercourse of affairs. We have given grave consideration to this problem, and have decided that in order to develop these enormous territories in future it is necessary that exceptional encouragement should be given to the products of each part of the Empire. We believe that a system of preference can be established which will not involve the imposition of burdens upon food. We believe that it can be done without that; for purposes of preference it would not be essential. You can secure that by other means, and more particularly by taking measures which other lands have taken for improving the communications between one part of their dominions and another. By these means the products of one country inside this great Imperial Commonwealth can be brought more freely, readily, and economically to the markets of the others."

This noteworthy utterance breathes the real spirit of Imperialism, and we have no doubt expresses the view of the vast majority of the population of the United Kingdom who have had their eyes opened through the war to the defects of insularism. To all these Mr. Lloyd George's speech will be a trumpet call.

The Methods Proposed.

As for the means which the Government propose to take to bring about this Imperial union, it rather looks as though the Government have in mind a specially organized and if necessary subsidized system of British shipping, doubtless with preferential port and harbour dues. But although it was said in the House of Commons that the resolutions of the Imperial War Cabinet left the question of food stuffs open and did not involve the taxation of food, this and Mr. Lloyd George's less restricted reference to "no burdens on food" being contemplated can hardly be meant to imply that no taxation of any article of food was meditated. The Government having committed themselves to the principle that the home production of food must be encouraged *in perpetuo* can hardly, we opine, maintain that condition without some measure of differential taxation, and they are doubtless well aware of the valuable incidence of the sugar duties, and will not want to deprive the Exchequer of this now well-established source of revenue. It must be rather assumed that the object aimed at is to guarantee that the price of food shall be kept at a reasonable level, and that so long as that is maintained—so long in short as there is no burden placed on food—the Government will hold themselves free to adopt just such ways and means as seem to them the most readily and naturally to achieve that object. Even the Balfour of Burleigh Committee, above referred to, assumed that it would be necessary to have a differential tariff in favour of products coming from the Empire, and the Government will doubtless find in the end that some such scheme is inevitable. But if they do not care to commit themselves at this early stage to any cut-and-dried policy, it does not matter very greatly; the real thing is that they have realized the potentialities of an Imperial Union and are resolved by some means or other to work it for all it is worth. For the moment we can let it rest at that, and while rejoicing at their adoption of so sane an outlook leave them to work out the stages of the plan as speedily as the exigencies of the war will allow.

The Advent of Rationing.

There is no disguising the fact that the U-boat campaign against the world's shipping is not being countered as readily as was at one time hoped; and as a result we are suffering shipping losses which will at all events involve us in a period of great stringency during the coming months till the next harvest is due. That Germany's efforts to win the war under the water will fail, there is still no reason to doubt, but the country has been far too tardy in realizing the fact that we are like a beleaguered city and all efforts to induce the population at large to restrict their consumption of food have been so far mostly a failure. The fact has not dawned on some, others are too inherently selfish, while a third and probably large section of the population are unable to bestir themselves to take a self-denying step which they see their neighbours do not trouble to observe; but they will readily enough submit to compulsion because the latter will equally affect the indifferent neighbours. The voluntary rationing has been responded to by about one-tenth of the population only. The result is, we are promised compulsory rationing within two months, unless in the meantime a very marked improvement in the country's rate of consumption is obtained. It will absorb much labour that might have been reserved for the prosecution of the war, and will undoubtedly inflict a maximum of inconvenience and possibly some degree of suffering on the population; but if the 90 per cent. who apparently refuse to respond to voluntary appeals are thereby taught a sharp lesson and are made to realize the situation more adequately, the severe trial will not be without its uses. A democratic nation which prides itself on its freedom must justify that possession. If it does not, then it merely helps to strengthen the claims which are made for autocracy.

Government Aid for a British Beet Factory.

Our readers will be interested to learn that an enterprise for the production of home-grown sugar, estimated to cost £500,000, has now been initiated. A communication to the Press states that a grant has been made by the Treasury of £125,000 by way of loan from the Development Fund towards the purchase of an estate of 5600 acres at Kelham, near Newark, where it is proposed to grow sugar beet, and to erect a factory for its manufacture into sugar. The enterprise is to be carried out by the British Sugar Beet Growers' Society, Ltd. The Chairman, Captain BEVILLE STANIER, M.P., recently appeared before Lord Selborne's Committee, whose interim report refers to the scheme.[1] The property has already been acquired on behalf of the Society by the Vice-Chairman, Mr. ERNEST JARDINE, M.P., and the members of the Committee include: Mr. H. G. ALEXANDER (Bath and West and Southern Counties Society, Major G. L. COURTHOPE, M.P., Principal M. J. R. DUNSTAN, M.A. (South-Eastern Agricultural College), Mr. S. F. EDGE, Mr. J. L. LUDDINGTON (Royal Agricultural Society of England), Sir HERBERT MATTHEWS (Central Chamber of Agriculture), Professor C. S. ORWIN, M.A., Mr. L. SOUCHON, the Hon. EDWARD G. STRUTT, and a number of other leading agriculturists. Messrs. W. T. CHADWIN, R. N. DOWLING, H. F. EASTON, W. J. HOSKEN, and GEORGE TURNER are assisting in an expert advisory capacity. Mr. ALFRED WOOD, who is in charge of the home-grown flax, hemp, and tobacco undertakings in England, financed from the Development Fund, is the Secretary.

---

[1] *I.S.J.*, 1917, 156

This announcement is welcome news; the Government have evidently acted with commendable promptitude in following up the recommendations of the Sub-Committee on Agricultural Policy that they should arrange without delay for a complete test of the commercial possibilities of manufacturing sugar from home-grown beet. In their report the Sub-Committee, it will be remembered, thought fit to mention this venture of the British Sugar Beet Growers' Society as a sound scheme thought out with great care,[1] and therefore worth the Government's support. As this latter aid is now forthcoming, it may be assumed that the Government will not stultify its effort by dropping the surtax protection which the home venture would enjoy. We gather, indeed, that a stipulation to retain it was one of the agreed points between the two parties.

In view of the fact that hitherto the Treasury have invariably raised a *non possumus* when the project of advancing money for such a scheme was advocated, both on the ground that the provisions of the Brussels Convention precluded it, and that the Development Funds Act did not allow for the subsidy of an experimental industry worked for profit, there will be some speculation as to how the difficulty has now been overcome; it is not mentioned in the public announcement just lately accorded us, and the Government evidently prefer to maintain their own counsel for the present. We hardly suppose that the Kelham project is to be run on any other than a profit basis (though profit is essentially not the primary object of the promoters), so we are left with the conjecture that a more enlightened Treasury opinion has swept the ensuing difficulties aside. Not unlikely, in view of the Sub-Committee recommendations, it may take the form of amending the said Development Funds Act, in which event the introduction of a rectifying Bill into Parliament cannot be long deferred As for the other objection, the Brussels Convention is evidently no longer a bar. It has not been definitely denounced as yet, but it can hardly be considered other than a defunct agreement.

Although these points have still to be cleared up, they are only minor ones. The great thing is that the Government have at length recognized the wisdom of aiding both morally and financially a really sound scheme to add to our agricultural rota one of the best and most beneficent crops that our farmers could possibly desire—that is, when they have been taught by example its full potentialities. We sincerely hope that no untoward circumstances will intervene to mar the complete success of the experiment, and we shall look forward with pleasure to recording the results obtained. We assume that, as we ourselves pleaded a few months ago, every effort will now be made to get the venture in full swing during the 1918 season, the earliest one available, and that shortage of building and engineering labour will not be found an obstacle to the completion of the plant within the time limit.

Sugar Supply of the Empire.

The London Section of the Society of Chemical Industry, which is the largest industrial chemical society in the world, has formed a Committee of experts in industries connected with sugar throughout the Empire to inquire into the question of providing a supply which should render the Empire independent of sugar from foreign sources. The Committee is composed of members of the Society of Chemical Industry, with such other outside experts as it has been found desirable to co-opt.

---

[1] *I S J*, 1917, 156

The subject matter dealt with will comprise not only the economic aspect, but also the technical side of the problems involved. Thus, the Committee will consider the wants of the Empire with regard to sugar, not only as to quantity, but also as to the nature required by the various users, and the best means of satisfying these wants. The subject of the development of technical education in regard to sugar production will also come under the consideration of the Committee, as this question has not hitherto received the attention which its importance warrants. As at present constituted the Committee comprises the following names, and it is proposed to co-opt others—whose names will be announced later—to render it fully representative:—

Sir GEORGE BEILBY, F.R.S.
Mr R BLAIR, of the Glebe Sugar Refining Co.
Prof. M J. R. DUNSTAN, of Wye Agricultural College, representing Sugar Beet Cultivation in the United Kingdom.
Sir RICHARD GARTON, of Messrs Garton & Co.
Mr. T. H. P. HERIOT, of the Glasgow Technical College.
Mr. J. W. MACDONALD, of Messrs. Henry Tate & Sons.
Mr. G. MATHIESON, representing the Manufacturing Confectioners' Alliance.
Mr. F. I. SCARD, representing Colonial Cane Sugar.

The Chairman of the London Section of the Society of Chemical Industry, Mr. ARTHUR R. LING, will act as Chairman of the Committee, and Mr. T. D. MORSON will act as Secretary.

British Sugar Statistics.

The Board of Trade statistics of Trade and Commerce for March only came out at the end of April, and then were found to be shorn of much of their customary detail. The desirability of withholding information which might prove of service to the enemy has caused the Board of Trade to decide on the exclusion of all particulars of the countries from or to which imports and exports are consigned. As a result we are given no details whatever of the imports of sugar either raw or refined, and only the totals of the sugar exports are vouchsafed. This restriction will evidently rule till the end of the war.

At the same time business firms who need details of the countries to which goods are exported will still be able to get them through the Chambers of Commerce or from the Department of Commercial Intelligence of the Board of Trade on guarantees of secrecy being given.

The American Output of Sugar Factories.

As long as the United States held itself aloof from the war, its engineers and manufacturers were very busy—it would hardly be exaggerating to describe their business as a roaring trade—in the design and production of more or less complete sugar factory plants, mostly for Cuba where American capital was very active in making the most of the good sugar prices the war had brought along in its train. As we have already pointed out, their success in getting orders was greatly enhanced from the fact that their hitherto formidable competitors in Europe were temporarily incapacitated from competing for the business offering. Now however we expect that with the entry of their country into the war the levels will gradually get adjusted to something nearer the old time position. American engineers will have other and more urgent calls on their labour; it will become a cardinal necessity of the United States to add very considerably to its defensive resources and supplies, and its engineers and manufacturers will experience, we doubt not, some of the restrictions if not embarrassments that their British contemporaries have had to put up with for nearly three years. This necessity will not be without its advantages; it will enable after-war competition to start on more even terms, and it will no longer be possible for the stigma to be levelled at Americans that they have helped themselves to our trade while we in Europe were struggling for the peaceful existence of the world; they have now thrown themselves into the struggle with a zest which seems to augur well for the results, and when competition is once more resumed it will assuredly be free from that touch of bitterness that might have arisen if the States had remained neutrals to the end. The friendship between us (with whom we couple France) and the American nation will gain immeasurably from their coming to the momentous decision to assist us, and future relations will almost certainly reflect its solidarity.

Notes on American Sugar Production.

(From our American Correspondent.)

The most important factor in the American sugar situation during the past month has been the armed rebellion against the established Government in Cuba. For the reason that one of the very first developments in the outbreak was the cutting of communications between the eastern and western ends of the island, information for several weeks after the beginning of the trouble was very meagre and consequently the sugar market was somewhat unsettled.

With the collapse of the revolt as an organised movement, which seems now to have occurred, it is becoming possible to judge somewhat more accurately the amount of damage inflicted upon the cane crop and the extent to which the outturn in Cuba this season is likely to be reduced from earlier estimates.

According to a statement prepared for me by the Director of the Cuban Government Bureau here the loss of sugar, chiefly from the destruction of cane, up to March 15, amounted to approximately 250,000 tons. The heaviest loss, estimated at 170,000 tons, was inflicted in the Province of Oriente. Losses in other provinces were placed at 50,000 in Camaguey, 16,000 in Santa Clara, 6,000 in Matanzas, and the remainder in small amounts scattered through the Western Provinces.

It is not contended by the representatives of the Menocal Government that these figures represent the full amount of the deficiency that will be recorded in the Cuban crop at the end of the season as compared with estimates made before the commencement of the harvest. While it is claimed that the danger of an upset in the Government of the Island Republic has been averted and that the menace of the rebellion to constituted authority disappeared with the capture of General Gomez the possibilities of serious loss through pillage, looting and burning of cane fields by the guerilla bands into which the rebellious forces have been split still remains and scattered reports of damage by these bands continue to be received from Eastern Cuba.

Perhaps a more serious menace is the disorganization of the labour situation which has been caused by the rebellion, accentuating the scarcity of labour which was severely felt before the outbreak. The interruption of transportation caused by the destruction of bridges and railway tracks is interfering seriously with the movement of cane to the mills and of raw sugar to the ports. Weather conditions in Cuba have been unfavourable during the past few weeks, and if the rainy season should begin early, undoubtedly many thousands of acres of cane will remain unharvested.

In view of these conditions the various statistical authorities are generally agreed that the Cuban crop cannot exceed the 3,000,000 tons produced last season and that it may fall somewhat below this figure. This reduction does not threaten any shortage of sugar for this market as not much more than 2,000,000 tons is likely to be required from Cuba in addition to home production, especially in view of the decline in exports of refined. It does dispose, however, of the possibility of any considerable excess in the sugar supply and the question as to the effect of Cuba's big production which was heard very frequently a few months ago no longer troubles the sugar trade.

The prosperous conditions attending the refining industry during the past year are reflected in the annual report of the American Sugar Refining Company to its shareholders which was made public last week. The report shows that profits from operation during the year amounted to $9,750,000 as compared with a little less than $3,000,000 during 1915. This remarkable improvement in earnings was due in part to the broader margin between the prices of raws and refined sugars which prevailed during the past twelvemonth and in part to the great increase in the volume of business for export account.

Figures contained in the report give the total shipments of refined sugar from the United States to other countries during 1916 as 703,885 tons as against 400,000 in 1915, 173,000 in 1914, and 37,000 in 1913. While it is not expected that exports during the current year will equal the volume attained last year, this will be due mainly to lack of shipping facilities in view of the heavy demands for tonnage in other directions. The report calls attention to the fact that the United States possesses refining capacity sufficient to provide for 1,000,000 tons of export business in addition to satisfying domestic needs, and suggests the interesting question of what proportion of the foreign business that has come to American refineries in such generous volume during the past two years they will be able to retain after the conclusion of the war. Viewed from here that would seem to depend more largely on developments on your side of the Atlantic than upon conditions in the industry here.

The meeting of the United States Sugar Manufacturers' Association—the national organization of beet sugar producers—which was held in Chicago last week, had a somewhat unsatisfactory season to review in so far at least as production was concerned, but the members of the Association brought very encouraging reports of the outlook for the coming season. Except on the Pacific coast, the seed from which this year's crop of beet sugar is to be grown is not yet in the ground, but an abundance of moisture during recent months is reported to have put the soil in nearly all the beet growing states into excellent condition. The acreage under contract by nearly all the sugar factories is larger than ever before, and no less than twenty new factories are in process of construction.

The difficulties which attended the securing of an adequate supply of beet seed last year are reported to have been overcome, so far as the present season is concerned, by the importation of a greatly increased quantity of seed from Russia and by the rapid growth of beet seed production in the United States. Sufficient beet seed is on hand to meet all requirements of the Spring planting, and arrangements are well under way to provide an adequate supply for 1918. From every point of view, therefore, the outlook for the beetroot industry is most encouraging at the present moment of writing.

March 22nd.

Tare on Sugar Beet.

In its Relation to the Farmer and the Sugar Factory.

By H. F. EASTON.

Much has been written on the advantage to be derived from the growth of sugar beet in England: the deeper and the more intensive cultivation· the increase in the succeeding corn crops: and the possession by the farmer of a new, profitable, and cash root crop. Much, also, has been written on the commercial advantage, and the political necessity, of the manufacture of our own sugar. Those who have studied the question are unanimous on all these points. But the more ardent may be the advocates of sugar beet, the more it behoves those with a practical knowledge of the subject not to lose sight, in the whirl of initial victory, of the many difficulties that must be realized in time, and guarded against with prudence and foresight. There is nothing in the whole range of cultivation and manufacture that cannot be splendidly overcome by us in this country; but from the very start we must aim at the best and, by pre-conceived method, must prepare to bridge the ditches. One of those ditches is the relationship between the farmer and the factory, and the careful and honest handling of the troublesome question of "tare."

Appeal to farmers to-morrow to grow sugar beet for your factory, and offer them any price you like—say, for example, 25s. per ton—and even tell them that tare will be deducted. Not five out of a hundred of these men will have the least idea, if left to themselves, of what that tare will mean to them when they come to receive their cheques. This is my first point. they must be made to understand it at the beginning, and be shown how to reduce it, lest they turn, in the end, and rend the factory with disappointment that could have been avoided. Tare is perfectly capable of rational control; but it must be explained to farmers, and they must be shown how to control it, and shown in time. This is national work of immense importance that may justly fall within the sphere of the Board of Agriculture who, by tactful instructors working in harmony with the factory experts, could give guidance and help to the naturally conservative farmer, more acceptable at their hands than at those of the factory representative. Roundly speaking, there will always be a certain percentage of tare: the factory only pays for the perfectly clean, trimmed beet. the actual sugar-containing root, freed from all surplus matter and appendages that contain no sugar. The grower has to be made to understand that point. to keep him blind to it is only garnering mutual loss of faith when the "campaign" is finished. The whole future of the industry pivots on the farmers' faith and confidence in the honesty of the factory.

It is of the highest importance that at the initiation of the industry every factory should grow as large an acreage as it can of its own beets; but it cannot live without the farmer. By growing a big acreage of its own a treble purpose is achieved: the factory can be assured, off its own bat, of the necessary minimum volume of roots to keep it working; a practical demonstration is afforded to farmers of the value of scientific cultivation on a large scale, with its enhanced profit; and the factory is freed from the danger of being held round the throat by the growers who would, otherwise, have a monopoly of the factory's life-blood. Farmers must never be in the position, and must never be in the spirit, to say "we got on without you: you can't get on without us."

It is practically impossible that any large factory could ever own sufficient land to grow the whole, or anything like the whole, of the beet it requires.

Indeed, it is not to be desired that it should: because, if the beneficial effect of the crop is to be felt by agricultural England, it is the ordinary farmer, all over the face of our land, who must realize its virtue and become its staunch supporter. But to get the farmer to this state of conviction you must satisfy him that he has got a good thing, and that he has got an honest thing. I harp on the word "honest"; because, as the determination of tare lies in the hands of the factory, any carelessness or error in its statement will create suspicion. Suspicion once born, the careless growers will use it to cover their own poor returns; the epidemic will spread with material injury, and perhaps disaster, to the factory; and the cultivation of sugar beet will suffer unjustly at the very time when all must run smoothly. *The confidence of the growers must be gained, and kept.* If we imagine a factory dealing with an 80,000 ton crop of beet, probably not more than 30,000 tons of this will be its own cultivation. It may be assumed, for the sake of argument, that the remainder is grown on farms averaging, say, 120 acres each. These farms may usually have a quarter of their area in roots. Of this quarter fully a quarter, again, should be grown with beet: say 10 acres. This means that 500 farmers will be on the books of that factory. These 500 men have to receive individual attention and have to be kept firm in the faith.

We must aim high: we must have many factories. Mutual goodwill between the factory and the grower must, therefore, reign. Were we to exclude foreign sugar altogether, and allow for an increased consumption of cane sugar from our own dependencies, we could still keep about 150 large beet sugar factories fully employed in this country turning out the sugar we have hitherto bought from foreign countries. This would mean that, during the manufacturing season, some 60,000 men would be employed in and about the factories themselves—a good percentage of these all the year round: not to mention the extra hands employed on the land: the large increase in our own crops, and in our cattle-sustaining power.

It may be well here, first, to describe how tare is calculated by a sugar factory, and then to give some actual examples of tare taken from actual practice on a commercial scale, in cases where the farmers *had received practically no instruction.*

The beets arrive at the factory in a railway truck, in cart, or in barge. On entering the precincts of the factory the trucks and carts are weighed on their respective weighbridges, the weight of truck or cart deducted, and the gross weight registered together with the truck or cart number, against the name of the consignor. From each wagon a representative sample of fully half a cwt. is taken in a basket, just as it is found—beets, leaves, earth, and all—and is carried into a building fitted for the purpose with weighing and washing machines. The taking of the samples requires careful fairplay. In the course of transit much of the dirt will have settled towards the bottom of the truck or cart. Hence, if the beets are taken wholly from the top, the factory will wrong itself; if taken from the bottom, the farmer will be wronged. A good average sample taken throughout the whole depth must be drawn. Inside the building the contents of the basket are emptied completely into another carefully tared basket, on a correctly tested weighing machine; the gross weight, name of consignor, and number of truck, being at once registered. It is better, at this stage, not to pass the name of the consignor to this house, but to designate him by a number. The official controlling the tare, therefore, does not know with whose beets he is dealing, and the danger of favouritism is, consequently, eliminated. The beets in the weighed basket are now, individually, taken out by hand and have the *green crowns* cut off where the farmer has omitted to do this, and all fibres and ugly fangs detached. They are then thrown, one by one, into an open-work drum revolving, with others, through a trough of water. When the last beet has gone in, the drum is started and kept going until the roots are perfectly cleaned. The basket is tipped up to remove the loose earth ; the drum stopped ; and the beets emptied back into the basket. The loss of weight, on re-weighing, is registered as the tare, calculated per cent., and this is taken as the tare of the whole truck or cart. A certificate of each weighing, with full details, is sent periodically, throughout the day and night, to the factory office. In the office they will already have the gross weight of the beets in that particular truck or cart, as registered by the weighbridge on entering the factory. Every day a statement is sent to the grower showing the gross, tare, and nett of each of his consignments. This enables a farmer's attention to be drawn to any excessive amount of "dirt" he may be sending, and gives him a chance of improving matters at once both for his own good and that of the factory. Dirt is as much a nuisance to the factory as it is a disappointment to the farmer.

In the case of beets received by barge, the roots are unloaded by skips, preferably by crane. The number of skips is carefully counted ; each tenth one, say, being weighed and the average of the total of these being used to calculate the weight of the whole barge load. Varying according to the size of the cargo, a number of sample baskets are taken for washing, the average tare of these being taken as the tare of the barge.

It will be seen from this description what scrupulous honesty must be observed by the factory officials in charge of this department. Once a grower gets it into his head that there has been any trickery in unduly paring away his sample beets in order to increase the tare, he will never trust the factory again. Thereafter, every man who is honestly debited with a high tare may declare himself wronged. Even an innocent mistake by the factory in this department might be most serious in its consequences. The dirt washed from the beets is only a nuisance to the factory, and a considerable expense : so much so that Continental factories sometimes make a heavy increased deduction if the tare is found to be over 20 per cent. That would be the wrong method on which to proceed with English farmers. All the dirt washed by the factory from the roots will probably have to be provided for in settling ponds, whilst small stones adhering to the roots will have to be eliminated in the "stoning machine." Should these stones escape the "stoner," and reach the beet slicing machine, they will play havoc with the knives. Then, the rootlets and fangs on badly grown beets are useless for sugar ; they tend to clog the factory machinery with simple rubbish. Again, many farmers through pure carelessness, and some through a foolish idea of scoring extra weight, throw a large proportion of the leaves and tops into the trucks with their roots. That is all counted against their gross consignment as tare ; whilst, at the same time, it imposes on the factory people the trouble and expense of cleaning the dirt that has fallen to the bottom of the trucks before returning the empties. As much as two tons has sometimes been shovelled from a truck sent by a careless grower. Even the freight on that useless material is a serious matter.

It may be interesting to give some figures of crops and tares taken from actual practice on a commercial scale; it being understood that the men who grew these crops had never been properly advised. Had, as I am pressing, plentiful and systematic guidance been given from the start, most of the poor nett returns would have been up to the level of Nos. 3, 6, 9, 11, and 12, all of which were the work of thoroughly good and intelligent farmers and may be taken as typical of what the average is likely to be in this country, at the commencement, and under instruction.

		Per acre (tons).			
	Acres.	Gross	Tare	Nett	Tare, per cent
1.	2	11·83	0·78	11·05	6·59
2.	2	21·23	1·88	19·35	8·85
3.	4	21·84	2·42	19·42	11·08
4.	1	15·26	1·92	13·34	12·58
5.	10	14·25	1·91	12·34	13·40
6	6	15·01	2·16	12·85	14·39
7.	1	25·76	3·81	21·95	14·79
8.	5	23·39	3·58	19·81	15·31
9	20	14·89	2·44	12·45	16·37
10.	4	17·95	2·94	15·01	16·38
11.	20	12·49	2·53	9·96	20·25
12	117	10·95	2·22	8·73	20·27
13.	6	24·13	5·29	18·84	21·92
14.	7	14·56	3·18	11·38	22·53
15.	58	19·67	4·95	14·72	25·16
16.	3	4·50	1·42	3·08	31·55
17.	12	14·72	5·33	9·39	36·21
18.	96	4·44	1·72	2·72	38·74
19	3	16·43	8·10	8·33	49·21
20.	2	13·68	6·93	6·75	50·66

No. 18 grew on stony, shallow land, and utterly neglected his cleaning. Nos. 19 and 20 neglected nearly everything, and should never have been allowed to grow, they are notoriously bad farmers. The same may be said of No. 16.

If the soil is clayey, and the weather wet at the time of lifting, tare will be inclined to run high unless the farmer exerts great care; but it will not be beyond the mark to say that no tare should ever be above 20 per cent., and in very few cases over 15 per cent.

It is reasonable, during the infant years of the industry at any rate, that the Government should offer farmers an inducement for crops well-grown, clean, and rich in sugar content, sending skilled instructors to show them how they should carry out each of the operations of preparing the land, manuring it, drilling, singling, cleaning, and lifting The first couple of years would be the troublesome time; after that, they would have realized how proper culture had added to their crop and had reduced their tare, whilst the factory would have economized in trouble and would have gained in sugar. Beet sugar would have become a success.

Most farmers imagine sugar beets can be treated like mangels, but they cannot. The first striking point of difference is that a mangel grows out of the ground, whilst a sugar beet grows down into the ground, it tries to bury itself. It is desirable that it should do so, because any part of the crown that may be exposed to the light will contain very little sugar. Hence, sugar beets are sown on the flat. The exposed crown, probably covered with green matter, must be cut off by the farmer at the time of lifting Here is a loss against him to start with. He must therefore take care that, when cleaning, he does not scrape the soil from the roots, but rather gathers it towards them. Again, if the soil is shallow, or has not been deeply enough cultivated, the tap root will be unable to penetrate sufficiently far; the crown will be pushed above the ground, whilst the root, checked in its downward course, will form lateral fangs. When the farmer lifts his beets these fangs will draw up much soil and small stones with them. This "dirt," thrown into the cart or truck, will pay freight to the factory, there to be deducted as tare, for which the farmer will not receive one penny.

Clean, well-bred seed is another important factor, not only in yielding a high sugar content, but in reducing the tare. Well-bred seed gives a well-shaped root, long and tapering, without fangs, and easily lifted. Such a seed, sown in deeply cultivated soil, will penetrate far and, by reason of its depth, will maintain its foliage green and healthy through a season of drought that will probably ruin all the other root crops. For their own good, therefore, as well as for that of the factory, in the reduction of tare farmers must be taught the importance of the primary essentials: deep cultivation, good seed, keeping the crowns well covered, and good singling and cleaning. They must also be shown that the leaves of the beet make excellent feed for stock, or good manure for ploughing in. Once convinced of that, the factory is not likely to be troubled with them.

The points to be realized are that the farmer must, from the very first moment, be taught what he is doing, and how to do it to his own advantage; what he can reasonably expect if he follows advice; and, finally, he must feel that he is treated fairly by the factory which has as great an interest in his having a good crop as he has himself.

The Liming of Limy Lands.

By ARTHUR H. ROSENFELD.

It is a recognized fact in sugar cane husbandry that one of the best indicators of the fitness of a soil for the culture of this plant is the lime content, and it is equally well recognized among agricultural chemists in general that this lime content must always be considered in direct connexion with the carbonic acid or carbon dioxide content, for, even though a soil have large quantities of lime as shown by its chemical analysis, yet if this lime exists, for instance in the form of *silicates* of lime and does not contain a sufficient quantity of carbon dioxide to make this calcium available to the plants, the soil, so far as the cane is concerned, is in an analogous condition to a traveller from France who finds himself in England with an abundance of his national currency in his pocket book—he must get this changed into English currency before his money is really *available* to him as a purchasing medium.

The function of lime in a soil is as much physical as chemical. One of its most important physical characteristics is that it helps to reduce the size of the soil particles—or, perhaps, *separate* these particles would better express the idea, thus furnishing a much larger contact surface for the tiny root fibres and making the soil generally more easily cultivable and porous.

The biological action of the lime is also important, for, by correcting even slight acidity in a soil it assures the life of the organisms which, night and day, make the food in the soil available for the plants—perform the function of the exchange bureau in the case of the traveller cited above.

The most important function of lime in the soil, from the chemical standpoint is to make available the potash which exists therein, which, otherwise, remains in an inert and useless condition. As will be seen from the analyses given below, our Tucumán soils are generally rich in this element, but it is very probable that, due to the lack of available lime in our soils, this potash is also, in grand part, more or less unavailable.

SNYDER[1] tells us that if a soil has a lime content of from 0·3 per cent. to 0·5 per cent. and from 0·1 per cent. to 0·4 per cent. of combined carbon dioxide and is not strongly alkaline, it will contain a sufficient quantity of carbonate of lime for good development of plants. If, on the other hand, he continues, this soil contains mere traces of carbon dioxide, the lime will not be present in the form of carbonate, but, more probably, in the silicate form, in which case, even though the chemical analysis shows a high lime content, this soil will probably be insufficiently supplied with active combinations of lime.

---

[1] "Soils and Fertilizers"

SNYDER goes on to say that, in a soil having a neutral or alkaline reaction and a good basis of organic matter and lime, 0·15 per cent. may be considered as sufficient phosphoric acid, whereas 0·05 per cent. is considered as indicating a decided deficiency. He calls attention to the fact, also, that phosphatic fertilizers frequently do not give results until some lime combination is used for neutralizing the acid.

As regards nitrogen content, the same author states that soils containing less than 0·07 per cent. total nitrogen may be considered as deficient, although soils having as high a content as 0·15 per cent. or 0·2 per cent. of this element may fail to produce satisfactory crops due to some abnormal condition of the soil such, for instance, as the lack of lime compounds which are so indispensable for the life of the nitrifying bacteria. He considers, furthermore, that a soil which contains less than 0·1 per cent. of potash soluble in hydrochloric acid is likely to be deficient in this element and that a soil having 0·5 per cent. of carbonate of lime will always produce a better crop with a small amount of available potash than soils which are deficient in calcium. He states that, in general, the best agricultural soils contain from 0·3 per cent. to 0·6 per cent. of potash.

All of the above shows us the tremendous importance of lime in the soil and of the form of that lime, since this substance affects not only the reaction of the soil as regards alkalinity or acidity, but bears an important relation to the availability to the plants of the other plant food present.

TUCUMÁN SOILS.

Now, let us study for a moment a few typical soils of the principal cane-growing Province of the Argentine Republic—that of Tucumán. J. A. HALL, Chemist of the Tucumán Sugar Experiment Station, made an extensive study of representative soils of the Province in 1911 and 1912 and, in "La Revista Industrial y Agricola de Tucumán,"[1] the official organ of that Station, furnishes us with the following interesting analyses :—

In commenting on these analyses, HALL says :—

"These analyses have been selected as representing the various types of soils found in our canefields, from virgin soils to those carrying thirty-year-old stubble, as well as representing the soils of all parts of the Tucumán sugar district.

"An examination of these figures reveals the fact that, in general, these soils vary very little amongst themselves as regards the mineral constituents. The widest variations are encountered under organic matter and nitrogen, which is perfectly natural, since at least a part of the nitrogen is found in the organic matter, and therefore these two constituents ought to be found in more or less the same proportions. Also, it will be seen that these soils fulfil the requirements generally recognized as necessary for fertile soils by the best known authorities, *with the exception* of the carbonate of lime content.

"Although we find, in general, almost six-tenths of 1 per cent. of lime, the carbon dioxide, which is in combination with this lime, is present to the extent of only 0·02 per cent. A part of the lime present may be combined with the phosphoric and sulphuric acids, but one may safely say that the larger part is present as a silicate, which form is extremely slowly available for plants."

After studying the figures in Table I and reading the remarks of HALL, our readers will not wonder that we immediately decided to make

---

[1] Vol III. pp. 306—10, Dec., 1912

TABLE I.

Analyses of Soils from Tucumán Canefields.

All figures calculated to dry matter. Parts per cent.

No.	Description.	Insoluble Matter, SiO_2.	Organic and Volatile Material	Iron & Aluminium, Fe_2O_3 and Al_2O_3.	Lime, CaO.	Magnesia, MgO.	Soda, Na_2O	Potash, K_2O.	Phosphoric Acid, P_2O_5.	Sulphuric Acid, SO_3.	Carbonic Acid, CO_2.	Chlorine, Cl.	Total.	Nitrogen, N.
A	Virgin soil	82·71	7·90	7·77	0·62	0·45	0·23	0·42	0·13	0·07	0·04	0·01	100·35	0·29
B	,, ,,	80·02	10·14	8·68	0·41	0·23	0·37	0·44	0·07	0·09	0·02	0·01	100·48	0·29
C	,, ,,	85·30	5·26	8·17	0·42	0·13	0·27	0·66	0·06	0·05	*	0·02	100·23	0·10
D	,, ,,	80·98	6·93	9·65	0·77	0·16	0·17	0·96	0·10	0·05	0·04	0·02	99·85	0·21
E	,, ,,	81·85	7·65	8·66	0·64	0·23	0·21	0·74	0·14	0·07	0·04	0·01	100·24	0·15
F	Plant cane	82·94	5·80	8·97	0·64	0·22	0·17	0·87	0·08	0·07	*	0·02	99·78	0·16
G	,, ,,	82·33	7·25	8·64	0·62	0·19	0·23	0·75	0·11	0·10	0·04	0·02	100·28	0·17
H	,, ,,	81·59	7·78	8·69	0·57	0·43	0·36	0·35	0·06	0·07	0·03	0·01	99·94	0·26
I	Stubble cane	82·58	6·51	8·37	0·66	0·58	0·18	0·60	0·08	0·07	0·03	0·01	99·67	0·24
J	,, ,,	82·82	7·25	8·24	0·60	0·18	0·22	0·69	0·16	0·09	0·04	0·02	100·31	0·19
K	,, ,, for 30 years.	85·92	4·76	7·65	0·48	0·17	0·30	0·69	0·06	0·07	*	0·02	100·12	0·10
L	Fallow previous 6 ,,	84·49	5·41	8·51	0·58	0·20	0·27	0·62	0·06	0·05	*	0·01	100·20	0·12
M	Third year stubble cane Fallow previous 12 yrs	82·78	6·05	9·10	0·47	0·40	0·21	0·64	0·05	0·07	*	0·01	99·78	0·12
	Average	82·79	6·82	8·55	0·58	0·27	0·25	0·65	0·09	0·07	0·02	0·01	100·10	0·18

* Traces.

TABLE II.

Comparative Yields of Limed and Unlimed Cane Lands.

Plat	Age	Average Weight of Stalks.	Yield per hectare	Brix,	Sucrose	Glucose,	Purity	Manufacturing Value[2]	Kg Sugar[1] per hectare.
				Chemical Analyses of Juices					
		grms	tons	per cent	per cent	per cent	per cent	per cent	
I. Without Lime.	Plant, 1912	615	32·553	15·6	12·2	0·3	78·2	9·5	2163
	1st year stubble	765	42·500	18·0	15·6	0·2	86·7	13·5	4016
	2nd ,, ,, 1914	620	34·280	18·0	15·2	0·2	84·4	12·8	3071
	3rd ,, ,, 1915	455	30·533	14·2	10·2	0·7	71·8	7·3	1560
	4th ,, ,, 1916	425	14·838	13·9	10·4	1·0	74·8	7·8	810
	Average	576	30·941	—	—	—	—	—	2324
II. With Lime.	Plant, 1912	715	45·406	15·5	11·9	0·4	76·8	9·1	2892
	1st year stubble	770	44·400	18·8	16·5	0·1	87·8	14·5	4507
	2nd ,, ,, 1914	680	40·813	18·2	15·4	0·1	84·6	13·0	3714
	3rd ,, ,, 1915	520	35·233	14·0	10·1	0·8	72·1	7·3	1800
	4th ,, ,, 1916	420	15·136	13·6	10·1	1·0	74·3	7·5	795
	Average	621	36·197	—	—	—	—	—	2742

[1] Calculated from a basis of 70 per cent extraction on weight of cane

[2] Obtained by multiplying the percentage of sucrose by purity

Five Years' Production.

Plat	Tons of Canes, per hectare	Tons of Sugar, per hectare
I Without Lime	154·7	11·62
II With Lime	180·9	13·71
Difference in favour of Lime	26·2	2·09

The Liming of Limy Lands.

SOME EXPERIMENTS WITH LIME IN THE TUCUMÁN EXPERIMENT STATION.

These experiments were begun by HALL and the author in June, 1911. A plat of land in the Experiment Station grounds, measuring just 25 × 50 metres, or one-eighth of a hectare, was well ploughed with an ordinary share plough, followed by a subsoil plough and harrowed with a tooth harrow. Unslaked lime of good quality was then applied to one-half of the lot at the rate of 1600 kgs. per hectare, i.e., just 100 kg. to this plat of one-sixteenth of a hectare. The lime was distributed in the plat in small piles, which were lightly covered with earth, thus allowing it to slake slowly. A light rain (18 mm.) on June 18th aided materially in the slaking process.

The lime was then spread out on the plat by means of spades, and the tooth harrow once more passed over both lots in order not to have any difference in cultivation in the two.

Furrows were indicated with a small share plough and deepened with a large double mouldboard, and on the 26th of June the native purple cane was planted in two running rows per furrow and covered with the small share plough. The rows were made 5 ft. apart. On July 15th both plats were irrigated and, during the entire five years of the experiment, every process of cultivation, harvesting, etc., was identical in the two plats, hence we can easily attribute any difference in yield to the effect of the liming. No lime was applied after the first application. Crop dates were July 19th, 1912, August 20th, 1913, July 18th, 1914, July 12th, 1915, and July 14th, 1916, i.e., at comparative dates each year.

The detailed results of the five crops—one of plant cane and four successive ones of stubble—will be found in Table II.

Little comment is necessary on this table, for this is a striking case of figures speaking for themselves. Not only have we harvested an average of over five tons of cane per year from the limed plat more than from the unlimed plat, which represents about 400 kgs of sugar annually, but the average difference of the weight of the stalks for five years of 45 grms. shows us that not only has the cane sprouted better each year, as shown by the difference in tonnage, but also that the individual canes have been better nourished, since the average weight of the stalks from the limed plat is almost 10 per cent. greater than that of those from the check plat. On the chemical composition of the cane the lime does not seem to have had any notable effect.

Had the plat been re-limed after the fourth year, the results would have been more striking yet, as it seems that in the last crop all effect of the original liming five years before had ceased. In every respect, at the last crop, the two plats are more or less equal, in tonnage, weight of stalk, and amount of sugar produced per hectare.

Extensive experiments will be started by the author this year at the Santa Ana factory in Tucumán, embracing over a thousand acres with various types of soils, with and without irrigation and with varying quantities of lime—probably the largest experiment of the kind ever carried out at any one time. Much valuable data should be obtained from these results after several years of experimentation.

Under the Defence of the Realm Regulations, the Army Council have found it necessary to take possession of all stocks in the United Kingdom of Formaldehyde solution, 40 per cent., excepting lots of less than 10 gallons. Quinine and Phenacetin are also commandeered by the same Order.

Russian Sugar Notes.

All business matters in Russia are of course at the moment completely overshadowed by the great political upheaval that has supervened in Russian society. But the new and far-reaching situation in regard to society generally will hardly affect the staple industries of the country in so far as the politico-economic views of the new Government have yet to be declared. It is to be feared that the additional confidence calculated on in business as well as political circles has come too late to change very appreciably the programme of beetroot sowing already in existence, the limited dimensions of which have given rise to gloomy prospects in regard to the next campaign.

The prospects for sugar consumers in Russia, both in the proximate and less proximate future, are far from engaging. In the course of time the unhappy position that has grown up due to causes existing even before the war, but of course intensified by the fact of war, will be rectified; but the problem to be immediately grappled with is one of real scarcity of sugar, no longer fictitious, that is, held up by speculators as frequently enough happened before the war, but absolute scarcity that would exist even were speculation totally absent. The sugar industry of the country is not now producing enough for the inland consumption, and all indications at the moment point to a more intense scarcity, quite independent of any unwillingness on the part of either producers or merchants from any point of view whatever to put the goods at their disposal on the market. The decree promulgated by the defunct Government, admitting foreign sugar during the current campaign is sufficient evidence that the position is critical, and it may be assumed from the prospects of the succeeding campaign that the importation of foreign sugar will be a greater feature next year than this. It is of course to be presumed that an administrative act such as the admission of foreign sugar duty-free to meet an emergency will be allowed to stand by the new Government without any further confirmation.

The following particulars extracted from an official statement on the situation published in Petrograd show distinctly the progress of scarcity and its prospective continuance. The area given to beet, and ready for harvesting on 1st September (O.S.), 1914, including the western borders now largely occupied by the German armies, was 689,498 dessiatines; on the corresponding date of 1915, 670,384 d.; and in 1916, 591,624 d. The quantity of beetroot treated in the factories in these three years or campaigns was 77,489,053 berkowetz; 68,810,011 b.; and 53,931,987 b. The last figures of course are preliminary, and affect the sugar producing campaign now in progress and are called "expected."

The sugar produced from the season's beet in the 1914-1915 campaign amounted to 107,855,710 poods; in the succeeding campaign the quantity was 90,824,438 poods; and in the current campaign the quantity expected to be announced is 73,858,445 poods. Without giving the details of the balances of free and inviolable reserve sugars carried over from campaign to campaign, it will be sufficient to give the total available sugar of each campaign, that is, including balances brought forward. By so doing we obtain 132,011,102 poods for 1914-15; 118,603,696 poods for 1915-16; and 84,549,775 poods "anticipated" for the current campaign. The scarcity became more acute year by year, and was ultimately so pressing that the principle of carrying forward reserves to enable the Government to influence the market has had to be abandoned to such an extent that, as the statement quoted from shows, practically nothing was brought into the current campaign from that of 1915-16. That is, the 1916-17 campaign depends on its own production almost entirely, except what can be imported from abroad.

Russian Sugar Notes.

Passing from the discouraging aspect that confronts the Russian sugar consumer in regard to the current campaign, little comfort is vouchsafed by the report quoted from in its anticipations for the campaign of 1917-18. Dealing with the beetroot sowings, it says that according to reliable data furnished by the sugar factories, it is proposed this year to sow 633,938 dessiatines. This area exceeds to some extent that estimated for 1916, which was 612,257 dessiatines, which, however, in fact was only worth 591,624 dessiatines on the 1st September (O.S.); that is, at the beginning of the new campaign. Taking it, however, that the sowings expected will be effected and allowing a difference of 3·4 per cent. between the anticipation and the actual available beetroot acreage on 1st September, as in the case of 1916, we shall still find that the estimate for this year, in view of the considerable areas still under enemy occupation or menace, is remarkably high.

Taking it as correct, however, it does not correspond to the country's sugar requirements, to satisfy which, in view of the disappearance of reserve sugar, would require the product of at least 700,000 dessiatines of beetroot. Considerable difference of opinion exists as to what the price value of the root will be, but it is understood that it is going to be appreciably dearer than it was in preceding years. Therefore the question of price on which growers may rely so as to maintain their interest in the beetroot farms, is being actively canvassed; and sugar authorities are agitating for the taxed price of sugar being raised in anticipation, in order that the manufacturers may be able to assure the growers of remunerative prices, either taxed or in open market, for the beetroot; failing which, this latter may not be forthcoming even in the reduced quantity expected.

There are two export questions of, however, secondary importance only, that come into view; but which have (in regard to one at least) an important politico-economic significance for Russia, namely, the exportation of sugar to Finland and to Persia. In the case of the former it is a quasi-domestic question: but in the case of the latter it is one of political significance, for it is with sugar to a large extent that Russia exercises her economic influence in Persia. For both domestic and political reasons, therefore, an effort will be made, no doubt, to provide a margin of sugar for both these markets. That means an unnatural drain on the already existing resources: comparatively slight, in normal times, but very powerful in times of pressure. Thus we shall probably see Russia importing foreign sugar very largely; some of it finding its way into her own export markets. At all events, what she sends into these markets will have to be made good from abroad. As it stands, foreign sugar, including Chinese, is already being sold in the country; and Moscow merchants have committed themselves for large parcels.

The result of the war can hardly fail to be a considerable extension of the sugar industry in the Far East, and a corresponding reduction in the market there for Russian sugar, when the home situation becomes normal again. There is a strong movement in favour of making a big sugar industry in Siberia, greatly stimulated of course by the present scarcity.

Petrograd,
April 12th, 1917.

The death is announced at the age of 86, at Norwich, of Mr. FRANCIS SUTTON, F.I.C., the author of the standard work on "Volumetric Analysis," the first edition of which was published as far back as 1863. Mr. SUTTON, who was originally a pharmacist by profession, was County Analyst for Norfolk and held a number of other public appointments. He established a works at Yarmouth for the manufacture of acids and fertilizers, which business was acquired in 1894 by Messrs. PRENTICE BROS., Ltd. An eleventh edition of his well-known work, edited by his son, Mr. W. LINCOLNE SUTTON, in collaboration with Mr. A. E. JOHNSON, is now in preparation.

Juice Heaters.

By FRANK COXON.

Juice heaters in the cane sugar factory are to be found generally of four distinct types:—(1) High velocity heaters; (2) medium velocity heaters; (3) low velocity heaters; (4) pre-heaters; and a few notes on the construction and duties of each may be useful to some readers and enable the principles of operation to be better understood.

High velocity heaters.—These are often called high pressure heaters, and are those in which the juice is made to travel through the tubes at a speed anything between 300 to 500 ft. per min., the tubes being arranged in nests of from 2 to 4 tubes, giving many circulations or circuits. The tube plates are divided up into boxes of a size to suit the number of tubes in a nest, and it will be obvious that high velocity must be attained by the juice in only having such a few tubes to pass through.

The object of velocity is three-fold, first to create pressure, so that superheating of the juice can take place without ebullition in the heater, and this type is therefore used exclusively on superheat clarification work where a temperature of 235° F. is necessary. Secondly, to prevent the easy formation of scale that would take place where the juice is allowed to flow sluggishly in the presence of this heat. Thirdly, the transmission of heat from the steam to the juice is dependent and proportioned to the cube root of the velocity and therefore high speed will mean better transmission enabling either a smaller amount of surface to be used or longer intervals between the cleaning. These heaters are invariably made of a horizontal pattern and are fitted with hinged re-inforced doors, fastened by quick acting bolts; vertical types are rarely to be found on account of the difficulty experienced in suitably draining the numerous chambers.

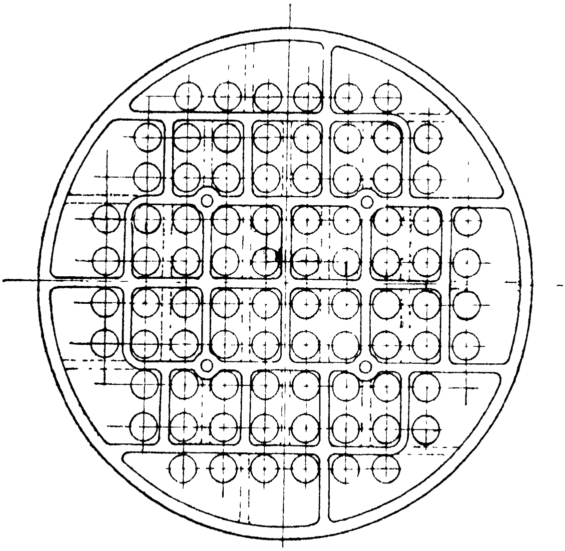


FIG. 1.
2-Tube Circuit High Velocity Heater Tube Plate Setting

Upon reference to Fig. 1, the disposition of the tube plate setting and head box divisions will be clearly seen, and the reader is referred to the November, 1916, issue of the *International Sugar Journal*, for some further notes on this type of heater.

To make the present comparisons complete, it may be repeated that heavy and substantial doors and fittings are necessary to stand the pressure which may rise to 45 lbs. per sq. in.; small diameter bodies are used to reduce the cost, since this is practically proportional to the area of the diameter consistent with the surface, and the use of steel-plate bodies is advisable.

Generally, the proportion of heating surface allowed suitable for the quantity of juice to be worked, is in the proportion of 1 to 7 or 1 to 8, that is, 7 to 8 gallons of juice per sq. ft.

Medium velocity heaters.—The use of medium velocity heaters can be traced chiefly to Continental practice, more so than either American or British, but the latter two have developed the use to a greater extent within the last five years. These heaters are made both horizontal and vertical, Continental practice favouring the latter type. The type of header is similar to that of the high velocity, but the juice is made to travel through a greater number of tubes at a time with a consequent reduction in speed and pressure. The headers however may now be satisfactorily made in cast-iron whereas steel was necessary in the other type; but it must be borne in mind that these heaters are not suitable for superheat (clarification) work unless proper provision is made to maintain a pressure on the juice consistent with the temperature desired. Fig. 2 will show clearly the disposition of this type of heater tube plate.

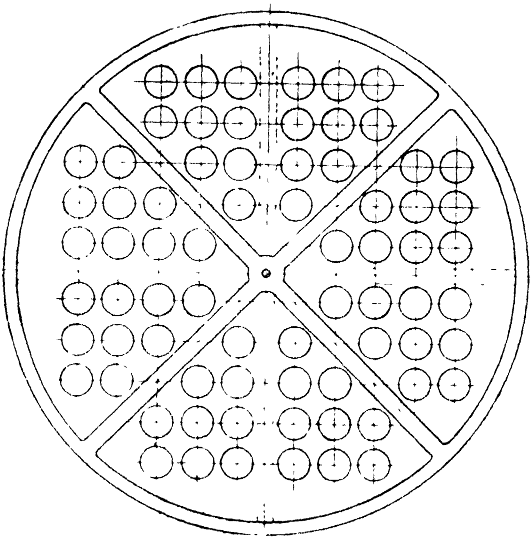


FIG. 2.
Medium Velocity Heater Tube Plate Setting

The horizontal pattern is made with hinged doors similar to the high velocity type but of less robust construction, and the vertical pattern is made either with covers to lift off with davits, or hinged and fitted with extending hinge bars on which are bolted balance weights. This heater is a very cheap form, and frequently to be found 8 to 10 ft. high, that is with tubes 8 to 10 ft. long allowing bodies of small diameters in proportion. The tubes used vary from 1 in. to 1¼ in. diam., the former being a very common size. Cleaning is accomplished by fitting a mud cock to each compartment in the case of the vertical pattern, and also a central plate is sometimes used which covers up an opening connecting each sector of the header; by removal of this usually small plate all chambers are instantly connected and drained.

The draining of the chambers of the horizontal pattern headers is accomplished by casting a small nick at each junction with the cover and header and, whilst of no size to seriously affect the working of the heater in allowing the juice to be by-passed, effectively drains each compartment to the lowest one where a drain cock is fitted.

Low Velocity Heaters.—This type is always made in the vertical pattern and is too well known to need description of a detailed character. Small sizes are to be found with three passes or circulations and large sizes with five to six circulations. Fig. 3 gives a typical tube plate setting and is only given for comparison with the two patterns described of higher velocity juice flow.

General comparison.—The following table will be of interest and explain very simply the difference in proportions and capacities:—

	Heating surface.	Galls. juice per hour.	Tubes per circuit.	No. of circuits.	Speed in ft. per min through each nest.
High velocity	500	3,000/4000	2	56/60	430
Medium velocity	500	2,500/3000	14	12/20	95
Low velocity	500	1,500/1750	60	3/6	8

The duties given in column 2 are the maximum that should be allowed without undue trouble in excessive cleaning spells; they represent figures sometimes used when an installation is purchased on price alone, regardless of other points, a feature too often the case in many transactions where liberal proportions are sacrificed, to bring later an inevitable use of extra man power and loss of efficiency. In superheat clarification there can be no question of the advantage gained in having a stand-by unit, the interest on the capital lying idle being considerably less than the cost of generating high pressure steam used to obtain the necessary temperature through foul tubes.

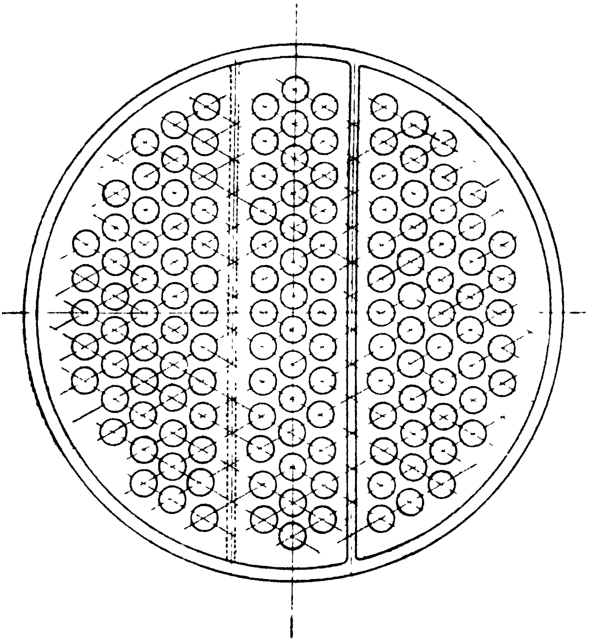


FIG. 3.

3-Pass or Low Velocity Tube Plate Setting.

Pre-Heaters.—These take many forms, the main theory of their introduction being to heat up the juice that is fed to the evaporator, and thus allow of the maximum efficiency being obtained from the apparatus. Too often evaporators are blamed for low capacity, when a moment's consideration will show the loss of efficiency taking place through the juice being fed in at a temperature much lower than the boiling point of the first vessel, this latter providing in many cases a heavy portion as a juice heating plant instead of as an evaporator, the duty for which it was designed.

It is now generally acknowledged that supplying the juice to the first vessel at a temperature of 200° F. instead of 180° F. a figure often found, means practically a difference in capacity or evaporation of 8 to 10 per cent., or in other words 2° loss in feed temperature means a consumption of extra steam of from ½ to 1 per cent., assuming quadruple effect is under consideration.

Another use for pre-heaters is the heating of the juice by vapour from the evaporators before going to the main heaters which are supplied by exhaust steam from the main. This vapour is usually supplied from the first vessel or a pre-evaporator, and may be above or below atmospheric pressure.

No modern central sugar factory is complete without these two methods in use, the generation of "extra" steam for use in pre-heaters and the heating of the juice to boiling point before feeding to the evaporators. In the former case it is usual to supply the first unit of the juice heater installation specially for this work, but of practically the same design as its successors. The latter method is usually carried out by fitting an ordinary pattern low velocity heater in the pipe line between the effect supply tank and first vessel.

An old method of pre-heating the raw juice preparatory to its heating proper in the main installation, and giving at the same time economy in the utilization of heat, was to fit a juice heater in the vapour main of the condenser. From an academic point of view there can be no question of its efficiency and economical points, since not only is the heat absorbed, which otherwise would go to the condensing water, but less water will be required for condensing purposes. Practice, however, has a very great say in its more common adoption, and one or two in Peru and Mauritius is as far as it has succeeded.

Pre-heating of the juice feed to the evaporator and "extra" steam generation has become and is becoming universal in American practice and Louisiana respectively, yet whilst the advantages have been known for many years adoption has been extremely slow from this country.

The flashed-off steam from superheated clarification is very often taken to a pre-heater or absorber constructed on similar lines to a low velocity heater, and yields no small return in heat economy when correctly designed.

The Employment of Electric Power in Sugar Factories.

By H. W. VAN DER LEE[1]

(Specially translated by Ed. Koppeschaar.)

(Continued from page 176.)

CONTINUOUS CURRENT MACHINES.

So far, we have enumerated the theoretical distinctions between alternating and direct currents. If, however, we want to be able to judge their pros and cons properly, we should know the properties of each system. Direct current admittedly enjoys some popularity, and this might lead us to look askance at polyphase current systems. For this reason the properties of the latter are here somewhat fully discussed.

As direct current machines are more generally known, only a brief survey of their features will be called for here. Direct current dynamos and motors are essentially the same thing: a ring or drum armature is made to revolve within the poles of a magnetic field, which is created by a winding on the magnet connected in parallel with the armature in the case of a "shunt" machine, and in series with that of a "series" machine. In a shunt wound machine the intensity of the magnetic field is very nearly independent of the load current; but in the series machine, on the contrary, the armature current also passes through the magnet winding and the strength of the field is in consequence entirely dependent on the load. A shunt dynamo gives a voltage which changes very little with the load, while a series dynamo gives a voltage which rises and falls with the load. Usually therefore the shunt arrangement is the one preferred.

With direct current motors the speed of rotation is largely dependent upon the strength of the magnetic field. A shunt motor with a field that is about constant will also have a constant speed. A series motor however has a speed which changes greatly; when the load is large, giving rise to a strong magnetic field, the speed is low, but when the load is small and the field weak, the speed is higher.

---

[1] In *Tijdschrift*, 1915-16, Nos. 11, 12, and 13.

In order that a motor may be strong enough to drive one or other tool, the motor couple must gain on the load couple. Now the strength of the motor torque is proportional to the strength of the field and of the armature current. With a series motor the field is strengthened simultaneously with the armature current when the load increases. The series motor has a very high starting torque and is especially adapted for motors for driving cranes. For the hoisting of heavy loads especially, a high starting torque is essential, while the hoisting of lighter loads takes place with weaker current, weaker field, and therefore with greater speed. Shunt motors are chosen in those cases where the speed of rotation must remain constant regardless of the load of the motor.

A compound machine is a direct current machine having both shunt and series windings on the magnets. Thus it has been endeavoured to combine the properties of shunt and series machines. The character of the machine approximates to that of a shunt or a series machine in proportion to the amount of the shunt or the series winding. The voltage of a shunt machine sinks a little when the load increases; if such a machine is equipped with a weak series winding, through which the armature current passes, then the magnetic field will be strengthened with a heavier load and thus the loss of voltage of the shunt machine will be compensated. The voltage of a properly compounded machine will therefore always remain constant under all loads.

A collector or commutator connected with the armature of direct current machines converts the alternating current, excited in the armature, into direct current to be tapped for use. The commutator is built up of a great number of copper strips insulated from each other and laid side by side in cylindrical form; the current is tapped or fed by means of brushes resting on the commutator as it revolves with the armature. Where sparking occurs under the brushes it may result in irregularities and abnormal wear, and the commutator of a direct current machine therefore needs a good deal of care and attention, because dirt or uneven wear will increase sparking and its consequent troubles.

THE COMPARISON OF THE TWO SYSTEMS.

When we compare the direct current and the polyphase systems, with a view to factory installations, we must chiefly take into account the behaviour and properties of the motors, as it is these which should guide us in our choice. In the case of polyphase motors, some rotors are short circuited and some are fitted with slip rings. The former are exceedingly simple. The moving part, the rotor, is not connected electrically with the supply circuit or with any starting device. The rotor winding is built up of copper bars insulated from the iron but all mutually connected, thus making the armature a short circuit in itself. The only frictional surfaces are the two bearings of the motor shaft. The motor is of a very simple type, and consequently is very safe to work, while its cost is appreciably less than that of a direct current motor of equal capacity. The starting is effected as explained already, with a single or else a star triangular switch or a starting transformer.

The large rotor currents which occur on account of the large slip experienced when starting, especially when the first method is followed, weaken the field, and the starting torque is consequently small; hence short circuit motors should be started either quite light or else only very lightly loaded; for instance, with only the transmission shafts running or else working only ventilators, or such like. Motors with slip rings whose rotor winding is connected by means of the slip rings and brushes with a starting resistance may be brought into action by connecting the stator to the supply circuit and cutting out the starting resistance little by little. As the stator field gains its full strength immediately and the rotor current can be reduced at will by a suitable resistance, the motor will start under full load. As regards starting, this motor is equivalent to a direct current motor. The construction however is simpler, and once full speed is reached it is often the practice to give to the motor, by the application of a slip ring short circuiting and brush lifting device, the character of a short circuited rotor motor, and it will give less cause for trouble than will the direct current machine, and will last longer.

Moreover, this type of motor will be somewhat cheaper than a corresponding direct current machine. A very compact and reliable combination is obtained when the starting resistance is built at one with the motor. If the stator switch and the safety devices are united with the resistance in one box, then the single switchboard for motor and connexion wires may be omitted. The starting up of the motor is accomplished by moving a single handwheel, through which is successively worked the stator switch, the switch for cutting out in a few stages the starting resistance, the short circuiting of the slip rings of the motor, and the device for lifting the brushes—one operation after another in the correct order, a device which enables anybody to handle these motors.

Any regulation of the speed however is not possible with these polyphase motors with short circuit rotor, the field rotates at a constant speed and the rotor follows the movement except for a small slip. Now we cannot increase this slip (and so reduce the speed of the motor) save by connecting resistance in the rotor circuit. Assuming the rotating field is constant, the current density in the rotor circuit will therefore have a certain value likewise. If the rotor resistance is a fixed value, then the rotor E.M F. will also be constant and therewith also the slip which causes this E.M.F. If on the other hand a resistance is introduced in the rotor circuit, then the E.M.F. and therewith the slip must increase in order to maintain the same rotor current. Any regulation of speed can consequently only be obtained from polyphase motors with slip ring rotors, by means of a regulating resistance with brushes in contact with the slip rings. Thus we can increase the slip and reduce the number of revolutions but we cannot make the motor run faster.

With direct current, we can regulate the speed downwards by means of a resistance interposed in series with the armature, and also upwards by weakening the field of a shunt motor by means of a resistance interposed in the series with the shunt winding. As the magnetizing of the field for this method of regulation costs but little in electrical energy, very little of the latter is lost in the shunt regulator. It is a so-called "regulation without loss" as compared with the regulation of speed downwards with both direct and polyphase motors where the regulating resistances consume a much larger current and an appreciable quantity of energy is dissipated, increasing as the speed gets lower. It is clear that in cases where a regulation of the speed is needed, the method of field regulation for direct current will be resorted to. But as such facilities for regulating the speed of polyphase motors are not so commercially available, the direct current system is the more popular.

Regulation of speed can be accomplished much more economically and more uniformly with direct current than with rotatory current. The efficiency of the smaller sizes (about 1 H.P.) can be fixed at about 73 per cent. in the case of direct current motors against 81 per cent. in that of rotatory ones.

APPLICATION OF THE TWO SYSTEMS.

When should we adopt direct current, and when the polyphase system? In factories where almost all the motors must run at constant speed during the whole of the working time, it is easy to see that our choice should fall on polyphase. If on the contrary, a great number of the new plant units which are to be driven need a speed which can be regulated at desire, then direct current is preferable.

In textile factories, the looms consume very little power and motors of 1 H.P. or less are sufficient for most of the machines. Here the polyphase motor in its simplest form, i.e., with a short circuit or rotor, is to be preferred. Such an installation is cheap and very safe to work.

But for electrical crane and hoist equipments, direct current series motors are preferred; these will hoist heavy loads at a low speed, light loads at a high speed, while the load can be braked electrically when being lowered. A machine shop using many tools, the speed of which must be capable of easy regulation, can dispense with any old-fashioned aids and connecting devices, such as stepped pulleys, gear trains, etc., by using direct current motors. In paper mills, to give another instance, it is necessary to regulate the speed of the motors more than anywhere else. Paper machines run at various speeds from 6 to 120 yds. a min., according to the fineness of the paper being turned out; thus, the speed must be regulated within the limits of 1 to 20, which we can only accomplish by means of direct current drive. In spite of this, many of these industries have adopted the use of polyphase system on account of the greater profit accruing. Even in paper mills, a large part of the tools run at constant speed. Since the method of field weakening is not sufficient for a speed regulation within so wide a range as is needed for such mills, the most economical solution is to choose a polyphase supply for the main circuit and instal rotary transformers (motor generators) for the tools which require direct current.

In big machine shops and on wharves covering a large area, polyphase current is preferable, the electrical energy being distributed over the system at high voltage, thus saving copper.

(To be continued.)

Messrs. GEORGE FLETCHER & Co., Ltd., of Derby, sent us a copy of a catalogue they have recently published dealing with modern machinery for small sugar plantations, including crushing outfits, juice heaters, clarifiers, open-fire boiling pans, Aspinal and Wetzel pans, boilers, and engines. Some of these apparatus might be supposed to belong to the past, but there is clearly still a demand for them in sugar districts where the capitalist has not yet exploited his means; and the reputation of this firm is a guarantee of good design. They will be pleased to supply copies of this publication upon request to interested persons, as well as any copies of their sectional catalogues dealing with more extensive plants.

* * *

The death of Mr. J. J. HAZEWINKEL, formerly Director of the Chemical Section of the Pekalongan Experiment Station in Java, took place at the Hague on February 14th. This well-known chemist was born at Groningen in 1868, and went out to Java in 1892 as technical manager of the Doekoewringin factory at Tegal. In 1904 he became sub-director of the Pekalongan Station, and when later this became divided into two sections he was appointed director of the chemical department, which appointment he held until February, 1914, when he retired to Holland. He was a most active investigator of problems concerned with the chemical side of sugar manufacture, and published much useful work, particularly connected with sugar losses and the decomposition of glucose.

Studies in Cane Sugar Manufacture.[1]

INVESTIGATIONS ON PROCESSES IN WHICH THE TOTAL CLARIFIED JUICE IS PASSED THROUGH FILTER-PRESSES.

By CHARLES FRIBOURG.

III.

Composition of "Phospho-Gelose."

The results of analyses which we made of this product at the commencement of our examination were as follows:—

	Per cent.	
Mono-calcium phosphate, $CaH_4 (PO_4)_2$	1·06	Total Phosphates, 70·40 per cent.
Dicalcium phosphate, $CaH (PO_4)$	68·73	
Tricalcium phosphate, $Ca_3 (PO_4)_2$	0·61	
Water, and organic matter	5·76	
Silica, and matter insoluble in hydrochloric acid	19·11	
Sulphuric acid	1·27	
Alumina	0·33	
Ferric oxide	0 87	
Lime	2·11	
Magnesia	traces	
Undetermined matter, by difference	0·15	
	100·00	
Total phosphates	70·40	
Weight, per litre of the material	450 grms.	

It would, therefore, appear that the two principal constituents are 75 per cent. of phosphates and 25 per cent. of kieselguhr and other products. It may be remarked that on the total phosphates there is about 97·60 per cent. of dicalcium phosphate, and we may add that the two principal products, dicalcium phosphate and kieselguhr, contained in the "Phospho-gelose" are of very good quality, and of a fineness very suitable for industrial use.

But, according to our results, the product contains too much phosphate and too little kieselguhr, and since the kieselguhr acts as the filtering agent, one is obliged to employ a rather large amount of the "Phospho-gelose."

Our late esteemed friend and colleague, Léon Pellet, published in 1914 an account[2] of the visit which he made to Brazil, where he had the opportunity of seeing several factories working with "Phospho-gelose." In all these *usines* kieselguhr was added to the "Phospho-gelose," and one of the most typical examples is that of the Passagem factory, which employed 6 kg. (13·2 lbs.) of "Phospho-gelose" and 4 kg. (8·8 lbs.) of kieselguhr per 28 hectolitres (616 gallons) of juice, that is, the following amounts per 1000 litres of juice:—

2·14 kg. of "Phospho-gelose," or 60 per cent. of the total "Phospho-gelose" and kieselguhr added;
1·43 kg. of kieselguhr, or 40 per cent. of the total "Phospho-gelose" and kieselguhr added.

Hence, for every 1000 litres of juice, the quantity of dicalcium phosphate and of kieselguhr were:—

1·5 kg. of dicalcium phosphate;
2·0 kg. of kieselguhr,

that is to say, figures which are absolutely in accord with our own conclusions.

---

[1] See also *I.S.J.*, 1917, 125-130, and 162-167.

[2] *I.S.J.*, 1914, 335.

In the experiments which we had occasion to carry out in 1914, we worked with " Phospho-gelose " alone without the addition of any kieselguhr, as one will see further on. Since that time, at our request, Mr. GUERRERO has modified the proportions of the two principal constituents in order to conform with our ideas, especially as certain eminent investigators, notably in Java, had come to the same conclusions.

Some experiments using a filter-press carried out in two different factories with "Phospho-gelose," both alone and with kieselguhr, will now be described, then a test on the large scale on the juice of the two houses. Lastly, the results of very detailed analyses of the scums obtained in the two cases will be given.

EXPERIMENTS WITH "PHOSPHO-GELOSE."

Factory A.

Test 1.—Sulphited juice originating from cane of 75° purity, incompletely matured, was used. 60 litres were limed, then treated with a mixture of "Phospho-gelose" and kieselguhr in order to have 2 grms. of dicalcium phosphate and 3 kg. of kieselguhr per litre. Thus, for the 60 litres, the quantities employed were:—

300 grms.	170 grms. of "Phospho-gelose,"	or 56·60 per cent.
	130 ,, of kieselguhr,	or 43·40 ,,

It required 2½ hours to pass 45 litres through and have the filter-press full, according to the following scale:—

11	litres in	10	minutes	without pressure.
22	,,	30	,,	pressure rising to 2 kg after 20 litres.
32	,,	60	,,	,, ,, 4 ,, ,, 32 ,,
42	,,	2	hours	,, ,, 4 ,,
45	,,	2½	,,	,, ,, 4 ,,

Subsequently, the scums were washed a little. They were then found to weigh 1·4 kg., and contained 7 per cent. of sugar, and 63 per cent of water. So that the quantity from 1000 litres of juice was 31 kg. of wet and 11 5 kg. of dry scums, their analysis being stated further on.

Analysis of the Juices.

	Sulphited Juice	Filtered Juice
Brix, by volume	17·61	18·30
Purity	75 80	75·4
Glucose, per 100 c.c.	1·88	1·92
Glucose, per 100 of sugar	14·00	13·90
Lime (CaO), per 100 of sugar .. .	—	0·36
Ash	0·58	0·59
Saline ratio	23·00	23·30
Acidity	0 820	0·100

Before sulphitation the acidity was 0·35.

Hence, there was a slight fall of purity; while the same juice worked in the factory by sulphi-defecation showed a decrease of purity of 1·5°, and contained 0·60 of lime (CaO) per 100 of sugar against 0·36, using the phosphate treatment.

Test 2.—This experiment was of the same kind as the last, but the juice used was a different one. Although it had a high purity, namely, 84°, the juice originated from cane which had been cut for several days, being dried and deteriorated. The juice was charged with bagasse dust, and filtration was rather difficult. Notwithstanding, 34 litres were passed through the press in 2½ hours, and 1·2 kg.

of scums containing 65·50 per cent. of water and 8·16 per cent. of sugar were obtained, the quantity of scums per 1000 litres amounting to:—

Wet scums	36 kg.
Dry ,,	12·40 kg.

Analysis of the Juices.

	Sulphited Juice.	Filtered Juice.
Brix, by volume	19·56	20·69
Sugar, per 100 c.c.	16·55	17·46
Purity	84·6	84·3
Glucose, per 100 c.c.	1·08	1·11
Glucose, per 100 of sugar	6·50	6·30
Ash, per 100 c.c.	0·46	0·43
Saline ratio	36·00	13·90
Lime (CaO), per 100 of sugar	—	0·47
Acidity, per litre	0·90	0·05

Before sulphitation the acidity was 0·40.

Test 3.—An example of an experiment using "Phospho-gelose" alone is now given, but it was necessary to use 6 grms. per litre, representing 1·6 to 1·8 grm. of kieselguhr only. The juice had a purity of 76°, that is to say, relatively low. It was possible to pass 45 litres through the press in 2½ hours, which was satisfactory, and the scums were washed a little with boiling water. In spite, however, of a rather heavy liming, the filtered juice had an acidity of 0·10. One obtained 1·4 kg. of scums, containing 61·50 per cent. of water, and 6 per cent. of sugar, the weight per 1000 litres being:—

Wet scums	32·5 kg.
Dry ,,	12·5 kg.

Analysis of the Juices.

	Sulphited Juice.	Filtered Juice
Brix, by volume	17·17	18·00
Sugar, per 100 c.c.	13·13	13·85
Purity	76·4	76·9
Glucose, per 100 c.c.	1·64	1·73
Glucose, per 100 of sugar	12·50	12·50
Ash, per 100 c.c.	0·62	0·63
Saline ratio	21·20	22·20
Lime (CaO), per 100 of sugar	—	0·30
Acidity, per litre	1·000	0·100

Before sulphitation the acidity was 0·400.

Factory B.

Test 1.—"Phospho-gelose" alone at the rate of 6 kg. per 1000 litres was used. The juice was of quite good purity, namely, 83°, and 50 litres were passed through in two hours' time, that is:

20 litres in 30 minutes without pressure.
23 ,, 1 hour, the pressure being 1 kg.
43 ,, 1½ hours, the pressure rising to 4 kg.
50 ,, 2 ,, ,, ,, 4 kg.

As already stated, in spite of a heavy liming the juices were slightly acid, owing to the large quantity of phosphates. The weight of scums was 1·38 grms., these being very compact, and containing 57 per cent. of water and 7·20 per cent. of sugar. Their weight per litre was:

Wet scums	27·60 kg.
Dry ,,	11·80 ,,

Analysis of the Juices.

	Sulphited Juice.	Filtered Juice.
Brix, by volume	20·43	21·13
Sugar, per 100 c.c.	17·00	17·68
Purity	83·2	83·7
Glucose, per 100 c.c	1·39	1·39
Glucose, per 100 of sugar	8·20	7·80
Lime (CaO), per 100 of sugar	—	0·51
Acidity, per litre	0·80	0·10

Before sulphitation the acidity was 0·30.

Test 2.—"Phospho-gelose" alone was again used, but 5 grms. per litre less than in the preceding experiment. This represents only 1·30 to 1·50 of kieselguhr per litre. Notwithstanding, and with a purity of 85°, the results are very good. In only an hour and a half 45 litres were passed through, and 1·20 kg. of scums obtained, these being rather soft (due to deficiency of kieselguhr). They contained 62 per cent. of water, and 7·2 per cent. of sugar. Their weight per 1000 litres of juice was:

Wet scums	27 kg.
Dry ,,	10·1 kg.

The filtered juice was neutral, and contained very little lime salts.

Analysis of the Juices.

	Sulphited Juice.	Filtered Juice
Brix, by volume	20·30	20·35
Sugar, per 100 c.c.	17·21	17·29
Purity	84·8	85·0
Glucose, per 100 c.c.	1·47	1·33
Glucose, per 100 of sugar	8·50	7·70
Lime (CaO), per 100 of sugar	—	0·22
Acidity, per litre	0·70	neutral

Before sulphitation the acidity was 0·250.

Test 3.—In this experiment 2·0 grm. of "Phospho-gelose" and 2·5 grm. of kieselguhr per litre of juice was employed, this representing about 1·5 grm. of phosphates and 3·0 grm. of kieselguhr. The juice was of good purity, namely, 84·8°, and it took two hours to pass 55 litres through the press. It was slightly alkaline after filtration. The weight of scums was 1·38 grm., containing 56 per cent. of water, and 7·7 grms. of sugar, this being per 1000 litres of juice:

Wet scums	25 kg.
Dry ,,	11 ,,

Analysis of the Juices.

	Sulphited Juice	Filtered Juice.
Brix, by volume	20·84	22·01
Sugar, per 100 c.c.	17·68	18·56
Purity	84·8	84·4
Glucose, per 100 c.c.	0·96	1·08
Glucose, per 100 of sugar	5·40	5·80
Lime (CaO), per 100 of sugar	—	0·36
Alkalinity, per litre	—	0·030

Before sulphitation the acidity was 0·30.

(To be continued.)

The English branch of the business of The Anglo-Continental (late Ohlendorff's) Guano Works has lately been acquired by an all-British Company and will henceforward be carried on under the same management as heretofore under the style of The Anglo-Continental Guano Works Ltd.

Simple Formulae for Mill Control based on the Relation of Weight of Dilute Juice to Weight of Cane Crushed.

By EDWIN B. HUGHES, B.Sc., F.C.S.,
Mauritius

A.—DEDUCTION OF RESULTS ARITHMETICALLY, SHOWING THE PRINCIPLES OF THE CALCULATIONS.

On page 499 of Noël Deerr's book, "Cane Sugar" (1911), the author gives a complicated formula requiring a good deal of time for working out. Another easier way of arriving at the same result will now be given. An example is here worked out arithmetically in full, to explain the method, but in actual practice the simple algebraic formulæ given under *B* may be used

Taking the same example as given by NOEL DEERR as cited above, and using the same notation, we have:—

Brix of absolute (normal) juice = 20·9 (B_c).
Brix of dilute juice .. . = 19·0 (B_j).
Brix of residual "juice" in bagasse = 8·80 (B_m).
Fibre per cent. of cane = 11·9 (f).
Fibre per cent. of bagasse .. . = 48·7 (m).
Bagasse per cent. of cane $= \frac{f \times 100}{m}$ = 24·43.
Absolute juice per cent. of cane = 100 — f = 88·1.

Dilution per cent. of absolute juice (normal juice) $= \frac{20·9 - 19}{19} \times 100 =$ 10 per cent., i.e., dilute juice $= \frac{110}{100} \times$ normal juice.

The total dilute juice, which would be obtained if no juice remained in the bagasse, would be $\frac{88·1 \times 110}{100} = 96·91$ per cent. of cane. (I)

Now the "juice" in the bagasse has Brix = 8·80; we must, therefore, convert this to its equivalent of juice of Brix = 19 (dilute juice). Thus: 19 parts of solids in 100 parts of dilute juice, therefore, 8·80 parts of solids in $\frac{100 \times 8·8}{19}$ = 46·316 parts dilute juice; i.e., 100 parts of "juice" from the bagasse = 46·316 parts of dilute juice.

But the bagasse "juice" in 100 parts of bagasse = 100 — fibre per cent. bagasse = 100 — 48·7 = 51·3.

Therefore 24·43 parts of bagasse (bagasse per cent. cane) contain $\frac{51·3 \times 24·43}{100}$ parts of bagasse "juice," and, in terms of dilute juice (B_j), this becomes $\frac{51·3 \times 24·43}{100} \times \frac{46·316}{100} = 5·805$ parts of dilute juice contained in bagasse per 100 parts of cane. (II)

Therefore *the dilute juice obtained per cent. of cane should be* 96·91 — 5·805 = *91·105.* (III)

This is the result actually obtained according to NOËL DEERR's formula, and not 91·25 as given by him.

The added water:

Normal juice obtained per cent. of cane $= \frac{91·105 \times 100}{110} = 82·823.$ (IV)

Therefore *the added water in the juice per cent. of cane* = 91·105 — 82·823 = *8·282*. (V)

Again :—

Canes + water added to bagasse = normal juice obtained + bagasse obtained.
100 + x = 82·823 + 24·43.

Whence *added water in bagasse per cent. cane = 7·253.* (VI)

Therefore the *total added water per cent. of cane* = 8·282 + 7·253 = *15·535*. (VII)

Total water in bagasse :—

Fibre = 48·7 per cent.

Therefore "juice" = 51·3 per cent., and its Brix is 8·80, so that the total solids in the "juice" = 51·3 × 0·088 = 4·514.

Therefore *the water in the bagasse* = 51·3 — 4·514 = *46·786 per cent. of the bagasse.* (VIII)

Thus, the percentage of water in the bagasse may be readily obtained by calculation.

B.—SIMPLE ALGEBRAIC FORMULÆ FOR THE RESULTS AS SHOWN IN *A*, AND DEDUCED IN THE SAME MANNER.

Dilution of absolute (normal) juice per cent. of absolute juice $= \dfrac{B_c - B_j}{B_j} \times 100.$

Total dilute juice, if none were to remain in the bagasse $= \dfrac{(100 - f)\,(100 + \text{dilution})}{100}$ per cent. canes. (I*)

Parts of dilute juice contained in bagasse per 100 parts of cane. $= \dfrac{B_m \times (100 - m) \times f}{B \times m}$ (II*)

Dilute juice obtained per cent. of cane = I — II = (III)

Normal juice obtained per cent. of cane = Dilute juice obtained $\times \dfrac{100}{(100 + \text{dilution per cent. of normal juice})}$ = (IV)

Added water in juice per cent. cane = Dilute juice obtained per cent. cane — normal juice obtained per cent. cane
= III — IV = (V)

Added water in bagasse per cent. cane = Normal juice per cent. cane + bagasse per cent. cane — 100
$= \text{IV} + \left(\dfrac{f}{m} \times 100\right) - 100$
or $\text{IV} - 100\left(1 - \dfrac{f}{m}\right)$ = (VI)

Total added water per cent. cane = V + VI = (VII)

Water in bagasse per cent. bagasse (i.e., "humidity") $= (100 - m)\left(1 - \dfrac{B_m}{100}\right)$ = (VIII)

C.—BRIEF DESCRIPTION OF LABORATORY METHODS FOR OBTAINING THE REQUIRED DATA.

1.—*Practical determination of fibre per cent. of cane.*—By "fibre" is understood the insoluble residue remaining after repeated extraction of the cane (or bagasse, as the case may be) with water. The pieces of cane obtained by careful sampling should be shredded and well mixed; take 100 grms. of this and extract with repeated quantities (about 100 c.c.) of boiling water (Zamaron's method), until the extract is about one litre; cool and make up to one litre. Dry and weigh the remaining fibre ($= f$).

---

* The figures (I) (II) etc., refer to the corresponding results in *A*.

2.—*Practical determination of Brix of normal juice.*—This method gives the true total solids per 100 grms. of juice—not the ordinary Brix reading. (Similarly B_J should be determined as total solids.) Determine the total solids in the above extract (No. I) preferably by the refractometer, or by evaporating to dryness a portion of the extract with sand. Calculate the solids in one litre of the extract ($= S$). Then $(100 - f)$ = juice in 100 parts of cane, when solids per cent. of juice $(B_C) = \frac{S \times 100}{(100 - f)}$.

3.—*Fibre per cent. of bagasse.*—As for fibre per cent. of cane, though the extract need not be so long; say, 500 c.cm.

4.—*Brix of "juice" contained in the bagasse.*—As for Brix of normal juice.

D.—A Simple Practical Application to Mill Control.

The calculation of the weight of dilute juice per cent. of cane crushed affords a valuble control of the latter, specially important when canes are bought for the factory.

The dilute juice should be weighed by automatic juice scales—or its weight determined from volume and density—a temperature correction being made if necessary.

If a water meter is used for measuring the water added during imbibition, then the weight of dilute juice per cent. of cane can be readily obtained without knowing the Brix of the normal juice or of the bagasse "juice," the only determination required being "fibre per cent. of cane" and "fibre per cent. of bagasse." For this control to be effective, all the water that can be added to crushed canes or juice before the latter is weighed must pass through the meter.

Canes + water added = dilute juice + bagasse.

i.e., 100 + water added per cent canes = dilute juice per cent. canes + bagasse per cent. cane,

whence dilute juice per cent. of cane = 100 + added water per cent. cane $- \frac{100 f}{m}$.

In the example already considered, suppose it is found that the water registered by the meter is 45·535 per cent. of the weight of cane crushed (as recorded by weighing clerk), then the dilute juice per cent. cane should be 100 + 15·535 — 24·43 = 91·105, and the result obtained from the recorded weight of cane and of juice should agree with this. Suppose, however, that a result of, say, 90 is obtained instead of 91·105 is calculated; then the weight of cane actually crushed must be less than that recorded, thus: Let x parts of cane be crushed for 100 parts of cane recorded as crushed, then the added water per cent. cane

$$= \frac{15{\cdot}535 \times 100}{x}, \text{ and dilute juice per cent. cane } = \frac{90 \times 100}{x},$$

whence $100 + \frac{15{\cdot}535 \times 100}{x} = \frac{90 \times 100}{x} + 24{\cdot}43$, whence $x = 98{\cdot}55$, i.e., the weight of cane actually crushed is 98·55 per cent. of the weight recorded as crushed.

According to a paper read at Philadelphia by Mr. H. A. Gardner, it has been found that calorific rays are conducted by painted objects in a widely varying degree This is a fact that should be noted by superintendents and others when painting tanks containing petrol or gasoline, or other light distillate. On exposing a number of small tanks containing benzene, painted in various colours, to the rays of a carbon arc for a period of 15 minutes, the rise of temperature in degrees Fahrenheit was: with black paint, 54°; with light grey, 26·3°; with white paint, 22·5°; with aluminium paint, 20·5°; and with tin paint, 19·8°.

A few Notes on Field and Factory Work from Peru.

By C. L. ROYLE.

Agricultural Chemist to The Cartavio Sugar Co. (Peru) Limited, Trujillo, Peru.

Having recently closed our accounts for last year, it was thought that a few notes on them would interest readers of the *International Sugar Journal*, so through the kindness of our general manager, Mr. C. MacDougall, I have been permitted to make some extracts.

It may be explained that as in Peru there is no definite season, grinding can go on all through the year, the only stop necessary being to put the factory in thorough order. There is also a slack time from about January to, say, April, or about three months, when the factory only grinds during the day; but this interval is used for planting, as it is at this time the water comes down, and all available labour and every effort is expended to plant as much as possible and as quickly.

FIELD.

	Average.	Maximum	Minimum.
Cane per acre	48·48	77·31	32·10
Sugar ,, (96°)	7·962	11·91	5·248
Sucrose in cane	15·770	17·61	14·52
Juice, Brix	21·15	22·90	19·83
,, sucrose	18·41	20·50	16·87
,, glucose	0·50	0·20	0·64
,, purity	87·01	91·1	84·1

Average area of the cane fields, 151·04 acres.

All the cane lands are irrigated, as there is no rainfall here.

Time to mature, 18 to 20 months.

Ratooned four to seven times; intensive cultivation, heavily manured.

The above figures are for the whole year and each section is closed separately. The best day's run was a sucrose content of 19·45 per cent. on cane. The climate here is best described as semi-tropical.

FACTORY.

The *hacienda* is a new one entirely, of up-to-date design, built by the Mirrlees Watson Co., Ltd. Its capacity is 1000 tons per day, and the sugar made is 96° standard refining, though it is also equipped to make white plantation granulated.

Factory yields.—Some of the figures extracted from the report of the year under review are as follows, and it is hoped that this year we shall improve yet further on these results:—

	Per cent
Sucrose in sugars	87·523
,, molasses	5·520
,, filter-press cake	0·787
,, bagasse	3·750
,, loss	2·420
,, extraction	96·25
Juice ,,	82·035
Recovery of sucrose in sugars, per cent. sucrose in cane	87·614
,, ,, ,, ,, ,, juice	91·087

The Cuban-American Sugar Co. has declared a quarterly dividend of 2½ per cent. on common stock, and 1¾ on the preferred payable on April 2nd to stock of record March 15th.

Correspondence.

CONDENSING SYSTEMS.

To the Editor, "The International Sugar Journal."

Sir,—I have read with interest Mr. Frank Coxon's articles in your February and March issues regarding pumps and condensers, but consider some of the statements might create a wrong impression of the rotary type of air pumps and condensers.

With rotary types of pumps, such as the Rees Roturbo and Le Blanc, the power required is entirely a question of air capacity, vacuum and temperature of water available. When these factors are low, the power required is much less than when high values are decided upon, so that it is not true to say that the same power is required for 27 in. as for 29 in. vacuum, as the following figures which are applicable to the Roturbo air pump or condenser will show :—

Vacuum	Temperature	Percentage power.
27	70° F.	100
27½	70° F.	120
27½	80° F.	160
28	80° F.	225

In comparing air capacity of the rotary and the reciprocating pumps generally, test figures, where available are usually in favour of the older type, but it should be borne in mind that test results of rotary pumps represent the *actual* conditions of working, whereas test results of slide valve and reciprocating pumps do not; these when tested in the shops draw dry air only, but when at work draw a mixture of air and vapour which greatly reduces their capacity due to the presence of moisture, condensation, and re-evaporation at each stroke, to say nothing of the leakages in service.

Rotary pumps are quite frequently specified to be suitable for 7 lbs. of air per 1000 lbs. steam, and that this unduly prejudices the use of these machines may be readily shown. For instance: a common rule for the volumetric capacity of slide valve pumps is 700 cubic inches p.m. per 10 lbs. per hour. This would give 7·1 lbs. air per hour at 27½ in. vacuum with 80° water, provided the pump had *100 per cent volumetric efficiency*. As, however, the efficiency will be more like 50 per cent. under actual working conditions, the actual air being dealt with will only be about 3½ lbs. per 1000 lbs. steam. It is, therefore, quite unfair to compare the power for a slide valve pump of this capacity with a rotary pump of double the air capacity, which shows that engineers should satisfy themselves on definite information rather than on general statements. A further point that might be emphasized is that the Rees Roturbo condenser is its own injection water pump and extraction pump combined with air pump in the one impeller, so that when comparing the power required with an ordinary barometric plant the power for the injection water pump should be noted as well as that for the air pump.

There are no "flying slices" in the Rees Roturbo air pump, and it may be of general interest to know that the action of the impeller may be visualized by imagining an ordinary wheel with a large hub, the hub representing the pressure drum or injection water pump, the spokes the sprays of water which radiate to the rim and entrain in the air in their passage. The rim of the wheel represents the fan-like blades which receive the mixture of air and water and positively expel it against atmospheric pressure. This description also applies to the rotary jet comdenser impeller.

Mr. Coxon's remarks regarding self-regulating pumps are timely, as the importance of this subject is not always realized. A self-regulating pump is one that does not call for an appreciable increase in power when operated at a less head than that for which it was designed. The ordinary centrifugal pump *can* be made partially self-regulating especially at low heads, but a universal self-regulating pump is absolutely necessary where varying lifts, such as on tidal rivers, etc., are met with, if economy in running costs is sought after.

James Hamill.

THE ELECTRIFICATION OF SUGAR CANE MILLS.

To THE EDITOR, "THE INTERNATIONAL SUGAR JOURNAL."

Dear Sir,—Mr. VASQUEZ is quite justified in calling attention to a serious arithmetical blunder in the review of "The Electrification of Cane Sugar Mills," which I sent you recently, and which you published in your October issue. The error is so vital that I do not feel justified in discussing any other of the points raised.

I regret any confusion that my blunder may have caused your readers.

Yours faithfully,

15/1/17. NOEL DEERR.

[⁂ The publication of this letter has been delayed pending further communication with the author. Its tardy appearance now is not Mr. DEERR's fault but is due to the difficulty of late in getting letters through between some parts of Cuba and this country.]

Publications Received.[1]

*** Handbook for Cane Sugar Manufacturers and their Chemists.** Guilford L. Spencer, D.Sc. Fifth Edition; partly rewritten and enlarged. xv + 529 pages; 4 in. × 6¾ in.; 93 figures; bound in leather. (John Wiley & Sons, Inc., New York; Chapman & Hall, Ltd., London, 1916.) Price: $3.50 nett; 15s. nett; postage 6d.

Spencer's well-known "Handbook" now appears in its fifth edition. Recent progress made in sugar technology, especially in processes for the production of high-grade sugars, have necessitated much amplification and deletion in the part devoted to manufacture, while the conditions of the very large factories now in operation have called for the revision of the chemical section likewise. The result is an enlarged volume that for the greater part has been rewritten.

Thus, in the chapters dealing with the extraction and the purification of the juice, descriptions are given of recent improvements, such as the Messchaert and Hind-Renton grooved rollers, Harloff's acid thin-juice process, Bach sulphitation, decolorization by "Norit" carbon, the Battelle process; while new apparatus, particularly for filtration, as the Kelly and Sweetland presses, is also discussed. A chapter on refining by Mr. GEORGE P. MEADE, Superintendent of the Cardenas Refinery, Cuba, has also been contributed, and is interesting as giving an idea of the methods of working as conducted in American sugar-houses. Altogether this section on manufacture contains a very wide range of useful and up-to-date information, though necessarily in a much condensed form, and it represents very fairly the condition of sugar technology at the present time in the progressive sugar-producing countries of Cuba, Hawaii, and Louisiana.

In the section on chemical control, among the new matter introduced may be mentioned the sugar refractometer, Wedderburn's method of reducing cuprous oxide to metallic copper in the determination of glucose, Steuerwald's modification of the double polarization method, and Eastick, Ogilvie and Lindfield's colorimetric sulphide method for the determination of iron in sugars and refinery liquors. Revised chapters are those relating to the compilation and interpretation of the analytical figures, and these are important in order properly to collate the data obtained for presentation to the management of the house. This chemical section, while otherwise very complete, disappointingly ignores the recent work done on the invertase and acid direct polarization modifications of the Clerget method, the results of which are appreciably *lower* in the case of molasses than those given by the ordinary procedure, but have been shown by several independent investigators indisputably it would seem, to be, nearer the truth.

---

[1] Books and other Publications marked with an asterisk (*) can be ordered if desired through NORMAN RODGER, 2, St Dunstan's Hill, London, E.C. 3, but in that event the order should be placed with him direct and not through a bookseller. Those not so indicated should preferably be ordered from the source of publication, especially pamphlets to which no price is attached, as these are in many instances gratis. Postage as a rule is extra.

Finally, additional tables have been included, while some have replaced older ones. This new edition well maintains the high reputation of its predecessors, and may be well recommended to manufacturers and chemists as a fully reliable introduction to the technology of modern cane sugar manufacture. It still appears in pocket-book form, neatly bound in black leather, and the illustrations and printing are alike excellent.

Tables de Concordances et Tables Diverses. [Tables Showing the Specific Gravity of Sugar Solutions with the corresponding Beaumé, Vivien, and Brix Degrees.] Société des Chimistes de Maurice. (Mauritius Stationery and Printing Co., Ltd., Mauritius.) 1916. Price: Rs. 2.00.

Tables indicating the absolute density of sugar solutions at $\frac{20^\circ}{4^\circ}$ C., and the corresponding Beaumé, Vivien, and Brix degrees have been calculated by certain members of the Société des Chimistes de Maurice, presided over, we believe, by Mr. Louis Baissac. They have been prepared from the most exact data obtainable, and are based upon the work of the Kaiserliche Normal-Eichungs-Kommission, after the recommendations of the 4th International Congress of Applied Chemistry, held in Paris in 1900. The temperature chosen is intermediate between the two normals hitherto most generally adopted, namely 15° and 25° C., and is that at which French saccharimeters are now graduated. It has been decided in Mauritius, we understand, to adopt the temperature of 20°C. as the standard, and to accept these tables for the carrying out of mutual control in the factories of that island. By the compilation and publication of these tables a distinct advance is made in the direction of bringing about the adoption of uniform methods of chemical control upon the most approved standards, and a marked service is thus rendered to the sugar industry at large.

Other useful tables are included in the volume. These show: (1) the saccharimetric readings for instruments having normal weights of 16·29 and 26·00 grms. per 100 c.c. and the corresponding percentages of sugar, with and without a dilution of one-tenth, the length of the tube being 20 c.m.; (2) constants for the calculation of the percentage of sugar, using the Steuerwald method of double polarization[1]; (3) the percentage of reducing sugars corresponding to the number of c c. used in the "colorimetric method"; (4) the volume of sugar solutions varying in concentration from 10 to 50 per cent., at temperatures from 0° to 100° C.; (5) the density, the volume and the weight of 1000 c.c. of water at temperatures from 4° to 35° C.; and finally a number of formulae of value to the technologist.

Chemical Engineering Catalog. 1916 Edition. (The Chemical Catalog Co., Inc., 1, Madison Ave., New York, U.S.A.).

This is a collection of catalogues and other data relating to chemical and metallurgical equipment, machinery, chemicals and supplies, condensed into a single volume for convenient and ready reference. It is in fact a chemical engineer's shelf-full of miscellaneous catalogues, condensed into a single book, and indexed and cross-indexed in such a way that one may be quickly directed to any particular information it contains. It is intended to publish it annually under the supervision of a Committee appointed by The American Institute of Chemical Engineers, The American Chemical Society, and The Society of Chemical Industry. This compilation promises to supersede the large mass of printed matter, relevant and irrelevant, issued by individual manufacturers, and to furnish in a small compass the largest amount of information, though only the nucleus is contained in the pages of this the first edition. If it fulfils expectations in this direction, it will take a welcome place in professional literature.

---

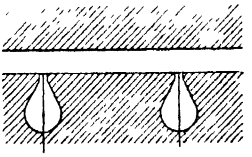
[1] *I.S.J.*, 1913, 489.

Review of Current Technical Literature.[1]

METHOD OF GROOVING MILL ROLLERS. *James H. Dod. La. Planter, 1917, 58, No. 7, 110.*

Referring to the article previously published by Mr. DOD,[2] one of his correspondents in the Argentina writes him to the effect that the arguments in favour of mill grooving appearing incontrovertible, owners of *ingenios* might be induced to channel their rolls if the difficulty of actually doing this did not present itself. A cutter to employ in the lathe to give the proper shape to the grooves, and to allow the metal cut away to get free of the channels, is required to put the improvement into operation.

A simple and efficient way of making the channels has now been invented by Mr. DOD. He has had the good fortune to devise what would appear to be the only way of readily reaching the desired object. By the means proposed the channelling can be done in the sugar-house as cheaply as in any machine shop, and thus the improvement is at once brought within the reach of all manufacturers. The mill itself takes the place of the lathe, and the old rolls need not be removed from their position, or otherwise changed at all, the motive power being obtained from the mill engine, while with two mechanics two rolls can be channelled at one and the same time. In order not to weaken too much the shells of rolls which already have been in use, the channels should be increased in number, but made only about half the depth they would otherwise have. The shape which they should have is shown in the illustration.



With the device proposed it is claimed that any good mechanic can channel rolls without removing them from their position, and the apparatus for effectively carrying out the operation is not heavy and can be transported from factory to factory, so that in the dead season the improvement could be extended over a large district at a comparatively small expense. No description of the outfit is given at present, because " to avoid all room for doubt as to whom the credit may belong," it is intended to patent it.

REPORT ON CRYSTALLIZERS AND CENTRIFUGALS. *George F. Winter. Proceedings of the Fourth Annual Convention of Sugar Mill Engineers, Honolulu, October, 1916.*

Crystallizers.—Most of the sugar-houses on the Hawaiian Islands have replaced the old-style coolers on wheels by U-shaped crystallizers equipped with stirring devices. Very few, however, are fitted with steam or water jackets, as the temperature is so uniform throughout the year that means for regulating it in the crystallizers are unnecessary.

In many, however, where the equipment of still coolers is good and the arrangement is satisfactory, their use is continued ; but the saving in labour, and the cleanliness which accompanies a crystallizer installation, make the change from cooler cars to crystallizers always a welcome one.

Crystallizers are in use in all sizes, depending upon the capacity of the pans, it being the aim in most houses to put no more than one "strike" in a crystallizer at a time, in order to observe the changes which take place in the massecuite so as to alter pan methods at will, which could not be done if "strikes" were dropped into crystallizers without regard to a maintenance of records. They are usually placed so that the massecuite runs into them from the pans, and is brought to any point along the length of the centrifugal mixer with a screw conveyor or by means of magna pump. In one factory the massecuite is run into the crystallizers with a flume 18 in. wide, 12 in. high and 100 ft. long, on a 4 per cent. grade, being delivered from crystallizer to mixer by means of a screw conveyor 12 in. in diam. and 60 ft. long.

---

[1] This Review is copyright, and no part of it may be reproduced without permission.—(Editor, *I.S.J.*)

[2] *I S.J.*, 1916, 36.

Usually the shipping sugars, when in the form of massecuites, are left in the crystallizers for a period of from 12 to 24 hours, but with low grade sugars about 96 hours is required for crystallization, depending wholly upon the quality of the juices being handled in the factory and the methods of boiling employed in the pans. It is customary, however, to use crystallizers for low grade sugars only.

The speed of the stirring devices varies from ¼ to 1 rev. per min., steam, water, or electricity being the motive power generally used. Belt-driven crystallizers are, in the opinion of the writer, to be preferred to crystallizers that are driven by means of shafts connecting the one with the other, for the reason that if there is any trouble with the worm or gear of any one crystallizer, the whole battery of crystallizers is not put out of commission pending repairs. There are, however, a number of installations where the shaft drive is used. One factory on Oahu has as many as eight crystallizers in a row driven by direct connexion from one to the other, which, after two years of service, is giving satisfaction.

Centrifugals.—It is considered good practice, where new centrifugals are replacing old ones, to use 40 in. rather than 30 in. machines. In fact, one factory on Maui is installing 48 in. machines, and we have knowledge of 60 in. machines being advocated for Cuba. The larger machines have found favour because, for a given cycle made up of the period for starting, running and stopping, the quantity of sugar dried is greater than in a smaller machine.

Belt-driven centrifugals are in the majority in Hawaii, water wheels or water turbines being used, together with electric motors and the usual steam engine for furnishing power.

The subject of the water-drive machine *versus* the belt-driven centrifugal is still a live one for discussion, but opinion seems to point to the fact that the greatest efficiency is attained with the belt-driven machine, because of the small losses which occur between prime mover and centrifugal spindle.

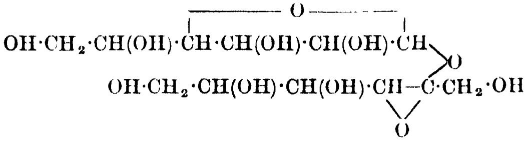
In the Lihue mill a steam turbine operating at 1800 revs. per min. at 90 lbs. pressure, belted direct to the main drive shaft, is used to operate the centrifugals. This was installed during the 1916 crop, and has proved to be very satisfactory.

CONSTITUTION OF THE DISACCHARIDES: STRUCTURE OF SUCROSE. ***Walter N. Haworth and James Law.*** *Journal of the Chemical Society*, Transactions, *1916*, *109*, *1314-1325*; through *Journal of the Chemical Society*, Abstracts, *1917*, *No.* *652*, *1*, *80*.

When octamethylsucrose is hydrolysed by means of hydrochloric acid, the rotation only changes from $[a]_D$ + 66·7° to + 57°, whereas a mixture of the known crystalline tetramethylglucose and tetramethylfructose would be levorotatory, like invert sugar. PURDIE and PAUL, however, have shown that an oily, dextrorotatory tetramethylfructose can be obtained,[1] and reasons are now given for assuming that this belongs to the type of γ-fructose, that is, it contains in all probability an ethylene-oxide structure. It follows, therefore, since the glucose fragment is of the normal type (crystalline tetramethylglucose can be isolated), that the abnormal rotation must be due to the new γ-fructose form, that is, that when octamethylsucrose is hydrolysed, it yields the α- and β-forms of butylene-oxidic tetramethylglucose and the α- and β-forms of ethylene-oxidic tetramethylfructose. Consequently, the original sucrose contains the ethylene-oxidic fructose, and should be formulated thus:—

---

[1] *Journal of the Chemical Society*, Transactions, 1907, 91, 294.


O
OH·CH₂·CH(OH)·CH·CH(OH)·CH(OH)·CH
O
OH·CH₂·CH(OH)·CH(OH)·CH—C·CH₂·OH
O

The hydrolysis of sucrose can therefore no longer be regarded as a very simple process, for it may involve the production of the α- and β-forms of butylene-oxidic glucose and ethylene-oxidic fructose, and then the change of these into the more stable α- and β-butylene-oxidic fructoses.

SUGAR. *A. McGill.* *Laboratory of the Inland Revenue Department, Ottawa, Canada. Bulletin, No 343*

Standards defining sugar and icing sugar were established by an Order in Council on August 1st, 1914, and are published as follows: (1) Sugar is the product chemically known as sucrose (saccharose), and is at the present time found in commerce as obtained from sugar cane, sugar beets, sorghum, maple, and palm; (2) sugar whether sold as granulated, loaf, cut, milled, or powdered sugar shall contain at least 99·5 per cent of sucrose, and shall be free from any artificial colouring matter; and (3) icing sugar is a powdered sugar specially prepared for bakers' use, and may contain starch, not to exceed 5 per cent. by weight.

During December to February last, 175 samples of sugar were purchased by inspectors, and were examined by Mr. McGILL. Of these six were judged as "adulterated," since they were found to contain a blue dye, apparently ultramarine; one contained 99·3 instead of 99·5 per cent. of sucrose, while the rest were sold as brown or yellow sugar, standards for which have not yet been defined, these being passed as genuine in the sense of being true to name. Samples of icing sugar were also collected and analysed. Of 76 taken, four contained an excess of starch, one contained almonds, and one was "nearly refined" sugar, while the remainder were found to be genuine icing sugar with not more than 5 per cent. of starch, or else no starch at all.

VARIEGATED CUTWORM PEST OF THE SUGAR BEET IN CALIFORNIA. *G. E. Bensel.* *Journal of Economic Entomology, 1916, 9, 303-306.*

The variegated cutworm (*Peridroma margaritosa (saucia)* Hubn., which has become very common in Ventura, has during the last few years been responsible for widespread havoc to beet, but especially when the season was cold and foggy. The larvae of the insect remain concealed during the day in the ground, at a depth of 3 to 5 cm., and come out at night in search of their food They sometimes attack the aerial parts of the beet to the extent of entirely stripping them of their foliage. In some cases the attack extends to the roots, which are more or less spoilt and gnawed. Among the natural enemies of *Peridroma* there are two species of *Calosoma*, *C. semilaeve* Lev., and *C. cancellatum* Esch.

The following artificial means of control have been successfully applied: (1) The application of arsenical compounds by means of sprayers fitted with a special 1 H.P. petrol apparatus which serves to maintain a pressure of about 120 lbs. during the operation; (2) applications of aceto-arsenite of copper in powder, applied in the morning when the leaves are still covered with dew, which facilitates the adhesion of the preparations; (3) the use of light traps (electric or acetylene lamps near which are placed receptacles containing water to which paraffin has been added), in which way 1,000,000 adult insects were captured in a single season.

J. P. O.

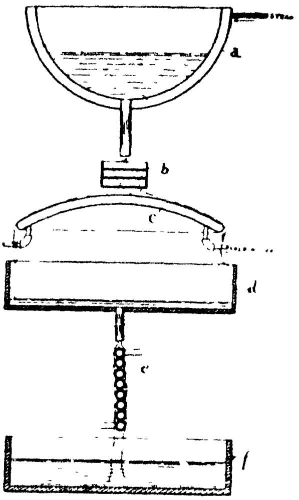
Review of Recent Patents.[1]

UNITED STATES.

MANUFACTURE OF INVERT SYRUP ("NULMOLINE"). *Noah W. Taussig*, of New York, N.Y., U.S.A. *1,181,086.* Patented, April 25th, 1916.

An aqueous solution of cane sugar is boiled with a very small quantity of citric acid, the temperature raised, and then suddenly lowered before caramelization can take place. Gum arabic is also added to prevent the crystallization of the dextrose and levulose, and the result is a clear, colourless product, free from acid[2] and alkali. It is known on the market as "Nulmoline," and forms a glycerin substitute on account of its softening influence, being used by bakers to prevent the cracking of the surface of biscuits, cakes, etc., by tobacco manufacturers by reason of its hygroscopicity, and for other purposes for which a non-drying and softening material is wanted. Its analysis is:—

Direct polarization	20·80° V	
Sucrose by double polarization..	traces only	
Dextrose and levulose .. .	81·50	per cent.
Water (by difference)	18·475	,,
Ash	0 025	,,



Referring to the drawing, *a* represents a steam jacketed kettle in which in ordinary practice the ingredients are mixed in the following proportions: Eight barrels of refined granulated cane sugar, free from colouring matter, 90 gallons of distilled water, 32 ounces of citric acid in crystals, and 4 pounds of sun-bleached gum arabic Steam is turned on and the mixture is raised to 210° F. and kept between this temperature and 218° for about one hour, the mixture being stirred with paddles during that time to thoroughly dissolve the sugar. At the end of one hour more steam is turned on, the temperature is quickly raised to boiling point, and the charge is boiled until a temperature of 232·5° F. is reached. At this point the steam is turned off, about four gallons of cold water added to check the boiling, and the charge allowed to run out of the kettle passing through the screens *b* to the surface of the umbrella-shaped, water-jacketted cooler *c* The liquid spreads out from the centre of this cooler forming a thin layer and dripping from the edges into the tank *d*. The effect of the cooler *c* is to immediately lower the temperature of the liquid below the point where inversion of the sugar takes place and at once check the process. From the tank *d*, the liquid runs over the Beaudelet cooler *e* where the cooling process is completed, discharging into the tank *f* from which it is removed into barrels for despatch.

FACILITATING THE FILTRATION OF CANE AND BEET JUICES AND LIQUORS BY THE USE OF DECOLORIZING CARBON TO REMOVE PECTINS AND GUMS. *Abraham Wijnberg* ("Norit" White Sugar Co). of Amsterdam, Holland. *1,176,999.* Patented March 28th, 1916. See United Kingdom Patent, 3854, of 1915[3]

---

[1] Copies of specifications of patents with their drawings can be obtained on application to the following:- *United Kingdom:* Comptroller of the Patent Office, Southampton Buildings, Chancery Lane, London, W.C (price, 6d each). *United States*. Commissioner of Patents, Washington, D C. (price 5 cents each) *France* · L'Imprimerie Nationale, 87, rue Vieille du Temple, Paris (price, 1 fr. 05 c. each). The date given in the heading of United Kingdom specifications is that of the application of the patent.

[2] It is stated that the small amount of citric acid used is completely eliminated during the operation, probably by combination with the sugar to form organic compounds.

[3] *I S.J.*, 1916, 194.

REFINING RAW SUGAR BY WASHING IN CENTRIFUGALS, AND SUBSEQUENTLY CARBONATATING. ***Frantz Murke***, of Fort Collins, Col., U.S.A. *1,132,868*. Patented March 23rd, 1915. See United Kingdom Patent, 6661, of 1915.[1]

UTILIZATION OF CANE BAGASSE, COTTON STALKS, STRAW, ETC., FOR THE MANUFACTURE OF PAPER, GUN COTTON, ETC. ***Mark W. Marsden***, of Philadelphia, Pa., U.S.A. *1,165,689*. Patented, December 28th, 1915.

Cane bagasse, cotton stalks, straw or other material is cut into suitable uniform lengths (1 to 2 in.) and steeped in hot or cold water, allowing it to undergo a process similar to retting in the case of the flax plant, the effect of which is to loosen the outer coating of the bark and soften the woody fibrous tissue. The stock is run through a shredder in order to reduce it to a fibrous mass, and afterwards subjected to steam (10 to 40 lbs.), the result of which is to dissolve soluble carbohydrates, gums, etc., present, and convert the starch into sugar. This liquor is run off and inverted, fermented and distilled. The remaining fibrous portion is subjected to the direct action of steam at a higher pressure than previously, preferably while the material is being subjected to a shaking action in order to present all parts to the scouring and separating action. When so reduced, the pulp may be bleached or may be used directly for the manufacture of paper, gun cotton, or the like. Both the long bast fibres and the short woody ones are available for paper manufacture the one complementing the other, the long fibres interlacing and strengthening the sheet, and the short ones filling in and giving it body.

SUBSTITUTE FOR GLUE OR OTHER ADHESIVE. ***Victor G. Bloede***, of Catonsville, Maryland, U S A. *1,198,160*. Patented, September 12th, 1916.

Starch, either raw or slightly hydrolysed, is mixed in a suitable apparatus with two to three or more times its weight of water, and when thoroughly stirred into a smooth cream it is blended with 5 to 25 per cent. (on the weight of dry starch) of a mixture of caustic soda and sodium or potassium plumbate, a jelly-like paste ready for use thus being formed.

UNITED KINGDOM.

PRODUCTION OF A PEAT PRODUCT FOR USE IN AGRICULTURE. ***John J. A. de Whalley and Herbert C. Siegfried de Whalley***, of Park House, Lee, London, S.E. *14,487; 17,848*. Applied for, October 13th, 1915.

Peat is saturated with a relatively small amount of ammonia, just sufficient to neutralize the free acids and make the mass slightly alkaline. A suitable proportion, usually 5 to 20 per cent., of carbonate of lime is added, and the whole uniformly incorporated together. The state to which the peat is brought by this treatment with ammonia is favourable to the taking place of certain actions beneficial to the soil and the growth of vegetation in it; but these changes are liable to restore the original acidity of the peat to a greater or less extent, and so carbonate of lime is added to prevent this.

It may be advantageous to have the ammonia act in a "nascent state" upon the peat, and to realize this purpose in practice the following is the procedure adopted to give a very effective product: 1 ton of black or dark peat is dried in the air, or by means of a suitable machine, until it can be ground to a more or less fine powder, and 2 cwt of sulphate of ammonia in solid or in solution form is well mixed in by suitable means. Next 2 cwt. of carbonate of potash in finely powdered form is added and further stirring is performed. The production and re-combination of ammonia may now take place, and finally 1 to 4 cwt. of carbonate of lime is intimately incorporated with the mass, which is then ready to be put in bags for delivery to the place of use.

CONFECTION COATING MACHINE. ***Herman G. Doelinger***, of 1806, West Fourth Street, Davenport, Iowa, U.S.A. *101,001 (6969 of 1916)*. Applied for, May 16th, 1916.

Claim is made for a coating machine or tables, and means for facilitating the work of a gang of operators coating confection blanks with chocolate.

---

[1] *I.S.J.*, 1916, 578.

CENTRIFUGAL FOR THE CLARIFICATION OF DEFECATED JUICES OR REFINERY LIQUORS.[1] *James Hamill*, of 87, Merridale Road, Wolverhampton. *102,407* (*2144* of *1916*). February 14th, 1916.

In reference to centrifugal machines of the type in which separation is effected of either or both of the impurities of a greater or a less density than the clear liquid and discharged through hydraulically operated valves without stopping the rotation of the drum, the present applicant has heretofore proposed to employ hydraulically operated valves for the discharge of either or both kinds of the impurities aforementioned,[2] but these valves were constructed as a rigid tandem combination of piston and valve-head, the valve-head being within the drum and exposed to the pressure of fluid in the drum whilst the piston was exterior to the drum and arranged within a pressure chamber rotatable with the drum, to which chamber fluid pressure developed by centrifugal force was supplied at will to move the piston and valve against their own centrifugal force and the centrifugal force of the material in the drum acting on the valve-head. The arrangement of the known valves for the discharge of the impurities of a less density than the clear liquid was moreover such that the whole contents of the drum were also discharged with the said impurities. The object of the present invention is to improve the construction and arrangement of such valves and to provide means for discharging the impurities of less density than the clear liquid through such valves without discharging the whole contents of the drum.

In carrying out the present invention, the impurities or other material of less density may be collected along a comparatively short strip of the inner wall by means of a suitably shaped annulus projecting out of the wall of liquid towards the axis of rotation and connected to the exterior of the drum by means of a conduit controlled by a hydraulically operated valve. The annulus is positioned so as only to allow of the discharge of a relatively thin section of the annular wall of liquid. The sides of the drum are inclined to facilitate the collection and retention of the heavy impurities which are discharged through a valve controlled orifice formed in the outermost portion of the drum. The valves controlling this conduit and this orifice are preferably operated from the interior of the drum and are arranged to move inwardly only against the action of their own centrifugal force and the resistance of any skin friction of the fluids along the valve tubes or rods as distinguished from being moved against their own centrifugal force and against the centrifugal force of the material in the drum acting on the valve-head. This is effected by arranging the auxiliary pressure chamber inside the drum instead of outside and by constructing the valve as a tube or rod with no projecting valve-head on which the fluid pressure of the material in the drum may directly act. Further improvements lie in arranging the piston to be slidably mounted on the valve tube instead of being rigidly connected therewith, and also in arranging the escape of the fluid from the valve pressure chamber to take place through the valve tube.

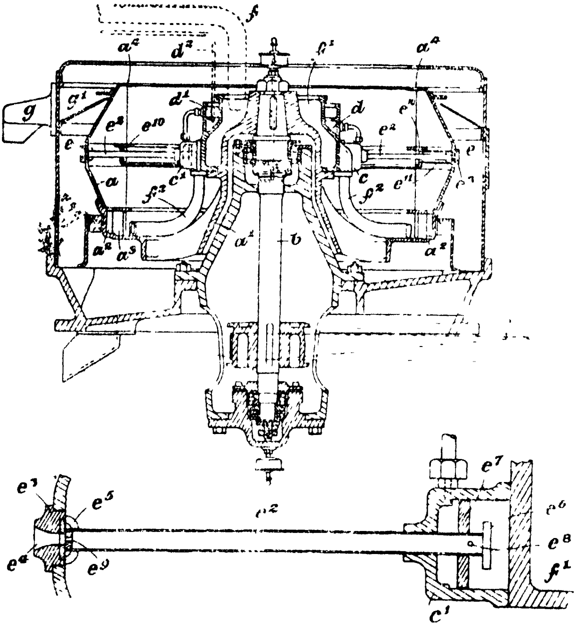
According to the particular construction of machine shown in the figure, the drum is shaped as a truncated double cone *a* formed with a hollow conical boss a^1 within which is housed an under-driven shaft *b*. A plurality of auxiliary pressure chambers *c*, *c* are arranged around the conical boss, and a suitably shaped reservoir consisting of two annular rings *d*, d^1 is positioned adjacent to said chambers, the ring *d* having connexions to the chambers *c* for operating the valves for discharging the light or less dense impurities and the other ring d^1 having connexions to the chambers c^1 for operating the valves for discharging the heavy or denser impurities

In practice, it has been found desirable to provide eight pressure chambers and valves altogether, six of these being used for the heavy impurities and two for the light impurities. Water or other fluid is supplied to the rings of the reservoir by means of the pipe d^2. This pipe may be controlled manually or by any suitable automatic arrangement.

The valves *e* and e^1 are preferably formed as hollow tubes e^2, the outer ends of which are adapted to bear against a removable plug e^3, screwed or otherwise secured to the outermost portion of the drum. This plug is formed with a conical discharge orifice e^4 which is normally maintained closed by the end of the valve tube, and is also formed with three or more inwardly projecting snugs e^5 or the like adapted to receive and guide the end of the tube. The inner end of each tube is formed with a flange or stop e^6 positioned within a pressure chamber, a suitably shaped piston e^7 being slidably mounted on the valve tube within the said chamber. Water or other fluid under pressure developed by centrifugal force is admitted to the chamber from the water ring in such a manner as to move the piston e^7 along its tube until it co-acts with the flanged end thereof and carries the tube with it, thereby opening the discharge orifice e^4. The valve tube is provided with a small leakage hole e^8 adapted to be uncovered when the piston engages with the flanged end e^6 of the tube The pressure water escapes through this hole into the tube and passes through a small orifice e^9 formed in the outer end of the tube thereby facilitating the discharge of the impurities If desired the leakage hole e^8 may be arranged to be normally covered by the guide flanges of the casing c^1, and to be uncovered only on the tube being moved inwardly.

---

[1] *I.S.J.*, 1915, 419. [2] *I.S.J.*, 1915, 434.



The annulus for collecting the less dense impurities is preferably formed as a U-shaped ring e^{10}, one limb of which is longer than the other and projects out of the annular wall of liquor. The light impurities collected under the short limb flow round the edge thereof into the U-shaped recess and pass into a hollow conduit or sleeve e^{11} leading to the outer wall of the drum. The valve tube e^2 for the light impurities is positioned within the hollow conduit and is of the same construction as that described in connexion with the discharge of the heavy impurities; the tube resting against a plug e^3 secured to the outermost portion of the drum and normally closing a discharge orifice e^4. The valve tube e^2 for the heavy impurities may be arranged to pass through a suitable bearing formed in the U-shaped annulus e^{10}.

In operation, the untreated liquor is supplied through a pipe f to a chamber f^1 from whence it is distributed by means of pipes f^2 to an annular recessed stepped portion a^2 preferably positioned at the foot of the drum from which it passes into the interior of the drum and assumes the shape of an annular wall of liquid. A grid a^8 or the like may be arranged within this recessed portion for the purpose of imparting rotation to the liquid; it being usually desired to bring the liquid up to substantially the same speed as the drum before the liquid starts on its upward course through the drum. In its upward course, the light impurities are forced towards the inner surface of the annular wall and collect under the U-shaped annulus or ring e^{10}, whilst the heavy impurities pass up the inclined sides of the drum and are collected in the apex or outermost portion of the drum, leaving an open passage for the clarified liquor which is continuously discharged through the orifice a^4 at the upper or opposite end of the drum to which the untreated liquid is supplied. The clarified liquor is collected in the groove g^1 and drawn off through the pipe g. The light impurities which are collected under the U-shaped annulus or ring e^{10} rapidly form into a short thick annular strip, and pass into the U-shaped ring. The position of the edge of the lower limb of the U-shaped ring determines the thickness of the strip of light impurities, which can be removed at one operation by opening the light impurity valve or valves e, and this edge is positioned so as only to allow of the removal of a substantially thin strip of material. The valves for the light and heavy impurities are preferably operated alternately. The use of these valves for the removal of the light impurities in sugar juice or like liquor has been found to give great practical advantages over the use of scrapers or the like, as the light impurities lie very loosely together, and are very liable if disturbed to mix again with the clear liquid. They must therefore be drawn off gently in the direction of their own centrifugal force, instead of being skimmed by scrapers, if an absolutely clear juice is to be obtained.

PREPARATION OF DECOLORIZING CARBON. *Alfred H. Bonnard*, of Ivanhoe Hotel, London, W.C ; *T. E. Rule*, of 22, Percy Street, Liverpool; *and James Nicol*, of 60, Addingham Road, Liverpool *10,622*. Applied for, July 31st, 1915

Carbonaceous material of vegetable origin, e.g., sawdust, woodchips, or the like, is heated in the presence of preferably not less than 30 per cent. by weight of a carbonate (or oxide) of an alkaline earth metal, e.g., calcium, the invention being characterized by raising the mixture to a bright red heat (about 1000° C.), while excluding air, this degree of heat being maintained for an hour or less, after which the mass is washed with hydrochloric acid until free from lime salts, and next with water, being finally washed and dried It has been found that by raising the mixture to the temperature of 1000° C., or even higher, a far more active charcoal is obtained than it is possible to produce at a lower temperature, and no water or steam should be intermixed with the charcoal producing substance. According to the Provisional Specification, after washing with water to remove the acid, the carbon is boiled with a solution of a caustic alkali, preferably caustic soda, again washed to remove the alkali, and then dried.

CENTRIFUGAL FOR THE CLARIFICATION OF LIQUIDS CONTAINING PRECIPITATES. *Thos. E. Brown*, of 17, Battery Place, New York, U S.A. *102,284* (*1277 of 1916*). Applied for, January 26th, 1916.

Claim is made for a machine of the character in which the rotating vessel is provided at its upper end with a cover held closed by centrifugal weights as well as with a moveable piston normally located at the lower end of the vessel, and when it is desired to eject the separated solids, some fluid (which may or may not be that under treatment) is admitted to the vessel underneath the piston, so that when the pressure below the piston due to centrifugal action preponderates over that above the piston, the latter is raised and first compresses the solids and afterwards raises the cover to allow the solids to be ejected.

CANDY MAKING MACHINE. *Richard J. Savage and Charles E Schultz*, of 321, West Austin Street, Chicago, Ill., U.S.A. *14,389*, Applied for, October 12th, 1915.

In prior machines of this kind, the vertical shaft carrying the "dasher" by which the stirring of the contents of the kettle is effected, must be lifted out by means of a block and tackle or pulley arrangement, or similar apparatus. In view of the fact that these machines in actual practice are usually at least 8 ft. in height, and require a clearance of 3—4 ft. for lifting the dasher shaft from the kettle, it has been difficult to use such plant in rooms where the ceilings are low. It is the object of the present invention to provide a machine which, although possessing all the salient features of the known machine, can yet be employed where economy of space is a necessity.

Method of Enriching Natural Guano or other Fertilizer. *Gerard Defries*, of 42, Mountfield Road, Church End, Finchley, London, N. *17,384.* Applied for, December 11th, 1915.

Sulphur dioxide is passed into a chamber containing guano or other fertilizer in the state of a moist or porous mass, and afterwards ammonia to form ammonium sulphite, which on being exposed to the atmosphere is oxidized to ammonium sulphate. Or the sulphur dioxide may be passed into a solution of ammonia, and the guano or other fertilizer saturated with the solution of ammonium sulphite thus produced, being subsequently exposed to the atmosphere to oxidize it.

UNITED KINGDOM APPLICATIONS.

Filter. *Zahm Manufacturing Co. 12,068.* August 25th, 1916.

Filter. *P. V. Yovanovitch. 12,072.* August 25th, 1916.

Compound Fertilizers. *C Deguide. 12,135.* August 28th, 1916.

Evaporator. *Chemical and Mechanical Processes Co , J. Harvey, and F. A. Hulme. 12,255.* August 30th, 1916

Beet Harvesting Machine. *T. V. Jensen. 13,947.* October 2nd, 1916.

Evaporator. *A. Hale and J. M. Simpson. 14,042.* October 3rd, 1916.

Cane Mill. *Geo. Fletcher & Co , Ltd., and J. Miller. 14,122* October 5th, 1916

Evaporator. *Kestner Evaporator and Engineering Co., Ltd., J. A. Reavell, and W. G. Mann. 14,208.* October 6th, 1916.

Dredgers for Sugar, etc *J. V. Chapman and W. Hudson. 14,556.* October 13th, 1916.

Evaporator, *W. A. E. Crombie. 14,510.* October 12th, 1916.

Cane Mill. *Geo. Fletcher & Co., Ltd., and J. Miller. 14,929* October 20th, 1916.

Evaporator. *W. L. de Baufre. 15,136.* October 26th, 1916.

Evaporator. *J. B. Watson. 15,114.* October 24th, 1916.

Centrifugal. *T. Broadbent & Sons, Ltd., and H. Broadbent .15,301.* October 27th, 1916.

Filtering and Purifying Cane and Beet Juices and Syrups, etc *R Harvey. 15,299.* October 27th, 1916.

Centrifugal. *L. Rasch. 15,397.* October 28th, 1916.

Apparatus for Removing Scale from Boiler Tubes, etc *Compagnie Générale de Détartrage des Chaudières et Conduits d'Eau. 16,034.* November 8th, 1916.

Filter Papers, etc. *A. Yeoman. 16,010.* November 8th, 1916.

Filters. *C. D Burchenal. 16,372.* November 15th, 1916. Under International Convention, United States, March 10th, 1916.

Water Tube Boilers. *D T. Scott. 17,501.* December 6th, 1916.

Manufacture of Alcohol from Grain, using Saccharifying Mucors. *Soc. d'Exploitation des Procédés H. Boulard. 17,596.* December 7th, 1916. Under International Convention, December 28th, 1915, France.

Centrifugals. *J. O. Drews. 18,097.* December 16th, 1916.

Evaporators. *Griscom-Russell Co. 18,336* and *18,342.* December 21st, 1916. Under International Convention, United States, February 1st, 1916.

Cloth Filters. *W. Boby. 18,394.* December 22nd, 1916.

Manufacture of Acid Calcium Phosphate or its Compounds. *B. Levin. 18,365.* December 22nd, 1916.

Packing Sugar. *C. Vautin. 18,413.* December 22nd, 1916.

Mill Housings. *R. R. Hind. 179.* January 4th, 1917.

United States.

(Willett & Gray, &c.)

(Tons of 2,240 lbs.)	1917. Tons.	1916 Tons.
Total Receipts January 1st to April 19th.. ..	986,030	968,146
Receipts of Refined ,, ,, ..	—	—
Deliveries ,, ,, ..	950,662	963,552
Importers' Stocks, April 18th	46,333	8,672
Total Stocks, April 18th	311,340	120,405
Stocks in Cuba, April 18th	514,123	873,332
	1916.	1915.
Total Consumption for twelve months	3,658,607	3,801,531

Cuba.

STATEMENT OF TOTAL EXPORTS AND STOCKS OF SUGAR, 1914-1915, 1915-1916, AND 1916-1917.

(Tons of 2,240 lbs.)	1914-15 Tons.	1915 16 Tons.	1916-17. Tons.
Exports	738,585	1,032,796	897,774
Stocks	509,082	746,896	640,481
	1,247,667	1,779,692	1,538,255
Local Consumption	21,130	25,600	29,800
Receipts at Ports to March 31st, 1917	1,268,797	1,805,292	1,568,055

Havana, March 31st, 1917 J. GUMA.—L. MEJER.

United Kingdom.

EXPORTS OF SUGAR.

	MONTH ENDING MARCH 31ST.		THREE MONTHS ENDING MARCH 31ST.	
	1916 Tons	1917. Tons	1916. Tons.	1917 Tons
BRITISH REFINED SUGARS :—				
Refined and Candy	832	113	2,720	387
Total	832	113	2,720	387
FOREIGN AND COLONIAL SUGARS :—				
Refined and Candy	72	1	400	6
Unrefined	6	54	52	214
Various Mixed in Bond	—	—	—	—
Molasses	52	1	480	8
Total Exports	**962**	**169**	**3,652**	**615**

Sugar Market Report.

Our last report was dated 10th January, 1917.

The Royal Commission on the Sugar Supply since the beginning of the year have had an increasingly difficult task to contend with, in distributing sugar to the trade. The quantities available become measurably smaller with the restrictions of tonnage allocated to sugar and the occasional loss of cargoes in transit.

In January the expectation still held good of a crop of 3,500,000 tons in Cuba, but the yield from the canes is said to be disappointing, and it is admitted that during the recent insurrectionary movement considerable damage was done by the burning of canes and the destruction of certain factories and railway material. The outlook for the crop has therefore changed considerably and present estimates range from 2,700,000 to 2,900,000 tons.

Figures of production in Cuba to the end of March compared as follows :—

	In Thousands of Tons.		
	1917	1916.	1915
Total to March 31st	1568	1805	1259
Total crop	?	3008	2593
Produced after March . ..	?	1203	1334

We have to amend as follows, our tableau of supplies (available for the actual years 1917-16- 15) derived from those countries whose production affects materially the statistical position in France, United Kingdom, and the United States.

	In Thousands of Tons		
	1917	1916	1915
Stocks in United Kingdom, 1st January.	119	137	414
,, in United States, ,, ,,	59	79	130
Louisiana .	270	123	216
Hawaii . .	575	530	577
Porto Rico . . .	400	431	308
Cuba	2800	3008	2593
British West Indies, San Domingo, Demerara, and Mexico .	495	481	463
Peru (Crop) .	250	250	262
Argentina (Crop) . .	100	150	335
Brazil (Crop) ..	225	194	240
Java (Export) .. .	1,300	1234	1020
Formosa and Japan (Crop)	436	405	262
Philippines (Exports)	170	316	243
Australia .	200	175	150
Mauritius (Crop) .	230	208	215
United States (Beet) .	800	775	780
Holland	-	4	130
	8429	8500	8338

The enforced curtailment of consumption in the United Kingdom, France, Italy, etc., probably reduces requirements by at least 500,000 tons for the year, hence the preceding tableau would appear to provide liberally for all wants, leaving a substantial balance of supplies to be carried into next year.

Exports of American granulated attained a total last year of 694,000 tons, but shipments to 19th April, 1917, were only 94,000 tons against 202,000 tons for the same period last year.

In comparing the present price of less than 20s per cwt. f.o b for New Crop White Javas, with that of about 32s. 6d. for prompt American granulated one must consider that freights from the East are scarce (much higher than from the West) and largely occupied with the transport of grain, etc , but the great disparity in the two quotations leaves sufficient margin to make it probable that White Javas might get the preference of the demand proportionately, as freight difficulties could be overcome. Java holders, however, are by no means in a happy position ; for, whereas last year some 700,000 tons were exported to Europe, reduced requirements on this side and the tonnage question must naturally affect badly the prospects of European business in the new campaign.

H. H. Hancock & Co.

10 & 11, Mincing Lane,
London, E.C.,
8th May, 1917.

THE

INTERNATIONAL SUGAR JOURNAL.

No. 222. JUNE, 1917. Vol. XIX.

☞ All communications to be addressed to "The International Sugar Journal," 2, St. Dunstan's Hill, London, E.C.

Cheques and Postal Orders to be made payable to "The INTERNATIONAL SUGAR JOURNAL," and not to individuals.

☞ The Editors are not responsible for statements or opinions contained in articles which are signed, or the source of which is named.

The Editors will be glad to consider any MSS. sent to them for insertion in this Journal and will endeavour to return the same if unsuitable; but they cannot undertake to be responsible for them unless a stamped addressed envelope is enclosed.

Notes and Comments.

Raw versus Refined Sugar.

On another page we report the substance of some questions and answers in Parliament regarding the alleged impurities found in the imports of raw cane sugar into this country during the last few months. It is seriously asserted by the authorities that consignments of sugar (of unnamed origin) contain the sugar louse (*Acarus sacchari*) and are hence unfit for putting into direct consumption. It is also alleged that the raw Cuban sugars landed here contain physical impurities. Hence the Government in their rôle of wholesale sugar dealers plus food controllers deem it expedient that this sugar should all pass through the hands of the already well-employed refineries.

Until more evidence is forthcoming to prove that this charge is well founded and is not the result of analysing an odd sack or two of a few abnormal imports, it will be hard to convince the sugar making interests that there is enough justification here for holding back a good deal of reputed high class raw sugar till it can be refined. On the contrary there will be a suspicion engendered that the refining interests are unduly swaying the decisions of the Sugar Commission and that more sugar is being refined than there is need for. Our refineries in normal times are not of sufficient capacity to deal with all our requirements in refined; and even if nowadays owing to the restricted consumption they be not fully employed, that is hardly a reason for passing through them (as we have some good reason to believe has lately been done) a number of raw sugar consignments quite fit for direct consumption, for the sufficient grounds amongst others that there is a general complaint as to the scarcity of sugar amongst domestic consumers, and the scarcity will not be lessened by the delay in refining or in the reduction in bulk by one-tenth through that process. For this reason we hold that the question of what sugar, as imported, is reasonably fit to go immediately into direct consumption, is one that should receive the most independent investigation possible.

The matter is one of more than ordinary import, because whereas till a few years ago the vast bulk of the sugar consumed in this country had perforce to undergo refining, either in the country of origin, e.g., in Germany and Austria, or else on arrival in this country, the necessity does not now hold equally good. With the recent introduction of improved methods of washing and curing in the raw cane sugar centrals, an increasing output of raw sugar sufficiently fit for direct consumption has developed, especially in Java, the home of the so-called "plantation white sugar." This sugar naturally dispenses with the final refining process using animal charcoal and therefore is in direct antagonism to the refiners' interests. But as it will fetch a higher price, it is in the *producer's* interests to turn it out and market it if he can. Hence if the Government are going to stand sponsor for our sugar supply in the future, they will have to consider the claims of the raw sugar producers in our colonies and elsewhere as well as of the refiner at home. It is not in the interests of the former that the public of this country should be educated into the belief that raw cane sugar is an impure product which must necessarily undergo refining. There will always be a demand for good refined sugars, especially for preserving; but there will be equally a big demand for direct consumption sugars once the public realize that a sugar of that kind may be quite pure enough even though its colour is a less clean white than that of refined.

The history of sugar in the United States is largely a struggle between the refining and the producing interests in which the former have always endeavoured to get the monopoly of all the sugar entering into the States; and for many years, it is interesting to note, the United States refiners boomed the *Acarus sacchari*[1] for all it was worth as a conclusive illustration of the necessity for issuing nothing but refined sugar to the consumer. A study of the history of the struggle between those refining interests and the producers who wished to be independent of that monopoly would, we take it, not be without benefit to those Government Departments at home who are nowadays having to try and master the technics of the sugar industry to a degree that is without precedent for them.

The Influence of Beet Cultivation on General Farming.

One of the expert advisers of the British Beet Growers' Society Ltd. in expressing approval of the Minority Report of Sir Matthew Wallace[2] appended to the Earl of Selbourne's recent Committee on Agriculture Report, emphasizes the fact that the successful growth of beetroots is the foundation of tillage operations and these roots are in the true sense the pivotal crops and not cereals, as the Majority Report seemed to consider. In a recent communication to the Society, he stated that he knew many hundred farms growing beetroot in Germany and Austria, all in a high state of cultivation which he could not say of many of the farmers dependent on cereal cultivation. Practically the whole Province of Posen was in a very backward state of farming some fifteen years ago, existing principally on cereal cultivation, but the successful North German beet growers' sons invaded that Province, introducing beet growing, and the many sugar factories operating there to-day show the flourishing state of agriculture in that Province. The increased intelligent connexions this industry brings with it inspires both masters and men to an increased energy. This is brought about by the necessity for more mechanical appliances, the possibility of the farmer knowing what each field is producing, and what each is lacking in the necessary fertilizer. This is secured at little cost to the farmer who has the assistance of the competent chemist employed by the beet factory to analyse the soil. This chemist's duties in the factory only occupy his time three or four months in the year, and he has time during the remaining months to assist the farmers; thus there is no slack part of the year on a beetroot growing estate, as from April to May the seed has to be got in, and before the cereal harvest comes the beetroots must have had several hoeing operations, and soon after the cereal crops have been secured the first beetroots are required for starting the factories, and the whole crop must be out of the ground, and under cover before the frosts appear, so that all hands are kept busy during the autumn and some part of the winter.

---

[1] An early reference to this insect is to be found in the *Sugar Cane* for November, 1871, where a good illustration prepared from a microscopic photograph is given A few copies of that issue are still available and can be obtained at the price of 2s. net.

[2] See *I.S.J* 1917, 157.

The Kelham Beet Scheme.

The projected beet factory at Kelham, Notts, which the British Sugar Beet Growers' Society, Ltd., are to erect, is intended to be capable of dealing with 1000 tons of roots per diem, which, on the moderate estimate of 10 tons per acre, would occupy about 8000 acres, producing about 80,000 tons of roots and yielding, on the basis of 14 per cent. sugar content, about 11,200 tons of sugar. The campaign would thus last about 80 days. Allowing a three-year rotation for the lands growing the beets, a total acreage of about 24,000 acres would be required. The factory estate is some 5600 acres in extent, so the hearty co-operation of the neighbouring farmers is needed to make the project a success.

The Korean and Manchurian Sugar Industry.

With a view to competing for the rich China market, capitalists are busy in Korea and Manchuria with beet factory projects. One mill is to be erected in Kokaido or Hsian-do at a cost of 1,800,000 yen, which is expected to work up 90,000,000 kin (531,000 long tons) of roots per annum. A second factory will be built later on by the same promoters, whose company has been formed with a capital of 5,000,000 yen (say, £510,000). Another, a Tokio company, with a like amount of capital, has obtained permission to establish a sugar manufacturing concern at Pyongyang, to start in October, 1918. A third project is for a sugar factory near Mukden, which is expected to be in running order by the end of this year, and which proposes to turn out 8300 tons of beet sugar and 11,900 tons of cane sugar. The beets will be purchased under contract from the Manchurian farmers while, we are told, it is proposed to import the sugar cane from Java or Formosa. This last statement is made on the strength of a British Consular Report; but it is more probable that it is a case of refining raw cane sugar imported from the countries indicated, as there is no evidence that there is any commercial feasibility of transporting canes in bulk, even if it were demonstrated to be possible in theory.

Jamaica: Government-aided Centrals.

The Jamaican Government—or perhaps it would be more accurate to say the Colonial Office—are now fully persuaded of the wisdom of State aid for establishing sugar centrals in Jamaica, so as to augment considerably the sugar output of that largest of our West Indian possessions. Sir Francis Watts, K.C.M.G., has been touring the island lately and meeting the sugar planters of the various parishes with a view to ascertaining the possibilities; he has already prepared a scheme for the establishment of Government-aided central sugar factories, and the Legislative Council are being asked to give effect to the proposal. The proposed agreement provides that the cane growers of a given district shall combine amongst themselves under contract to cultivate a sufficient acreage in canes to keep a sugar central in their neighbourhood employed, and shall form a company, the shares of which will be assigned to the Government to be held by the latter as security for the Government interest in the factory, and that on this being done, the Government will advance to the company a sum agreed upon for the erection and working of the factory.

The factories schemed for by Sir FRANCIS WATTS would have capacities of from 5000 to 10,000 tons. One such of 5000 tons is proposed to be erected at Vale, where once some 46 sugar estates existed. In addition to the State-aided projects, there are evidences that private enterprise is on the move, as it is reported that Messrs. GRACE & Co. are planning the erection of a factory in St. Catherine of 10,000 tons' capacity. Altogether, there are great hopes that Jamaica will before long revert to its one-time prosperity as a big sugar producer, even if it does not in the end exceed all records in output for the island.

The Brazilian Sugar Industry.

According to a report to his Government by the United States Consul-General at Rio de Janeiro,[1] of 30th January, the Department of Agriculture of the Brazilian Government estimates the total annual production of sugar in Brazil at 300,000 metric tons, equivalent to 5,000,000 bags of about 132 lb. each. Of these it is estimated that about 666,000 bags are produced in Rio de Janeiro, 1,800,000 in Pernambuco, 300,000 in Bahia, and 2,234,000 bags in the other States of the Republic. The total exports of sugar in 1915 were 59,074 metric tons, valued at 6,719,000 milreis gold,[2] as compared with 31,860 metric tons in 1914, valued at 3,311,720 milreis gold, and 5367 metric tons in 1913, valued 576,000 milreis gold.

The principal regions devoted to the sugar industry in Brazil are Maranhao, Rio Grande do Norte, Parahyba, Pernambuco, Alagôas, Sergipe, Bahia, Rio de Janeiro, Minas Geraes, São Paulo, and Santa Catherina. There are 76 large mills in Pernambuco, 31 in Rio de Janeiro, 25 in Bahia, 20 in São Paulo, and 15 in Sergipe. A large number of smaller establishments are scattered throughout the Republic; in Pernambuco alone, which usually supplies more than half of Brazil's total exports of sugar, there are 1500 of these.

The chief markets for Brazilian sugars are the United Kingdom, the United States, Uruguay, Bolivia, Chile, Peru, the Cape Verde Islands, and France. The United Kingdom has hitherto been the chief foreign customer for Brazilian sugar of the lower grades.

* * *

According to the figures compiled by the United States Department of Labour, the average retail price of sugar per lb. in the States during February 1916 was 8 cents and during the same month of 1917 8·1 cents.

* * *

The three principal American filter-press manufacturers, the Kelly Filter Press Company, the Sweetland Filter-press Company, and the American Filter Company, announce the organization of "The United Filters Inc.," a company formed to establish a selling service to supply modern filter equipment, which has bought all the patents covering the above-mentioned filters. The head office of the new company is at 321 Felt Building, Salt Lake City, Utah, U.S.A.

---

[1] Published in "Commercial Reports" (Washington) and reproduced from the *Board of Trade Journal.*

[2] Milreis gold = 2s. 3d. (par rate).

The Defence of Industry.

IV.

A Fool's Paradise. The Great Revolution. Cheapness—True and False.

This is the fourth chapter in our essay on The Defence of Industry. Our last concluded with what might appear a somewhat exaggerated view of the dangers ahead; but we know now that the words were not a whit too strong. We reminded our readers that in 1876 our Government declared that it might be desirable to assist British sugar producers to compete on equal terms with their foreign rivals, but that our system of commercial policy forbade it—especially as they might have "to do so in other cases also." "Here," we declared, "is the *laissez-faire* policy clearly defined for us by the Lords of the Treasury. The first duty of our present Government is to repudiate at once and for ever such a fatal doctrine, and to realize while there is yet time that all our main industries are in imminent peril. The attack will be sharp and sudden. Woe to this country if our Government is not prepared to meet and repel it. The military authorities gave them fair warning, which they disregarded and are now paying the penalty. A similar warning comes from those who know in the industrial sphere. If this is also disregarded we may look for the undoing of Imperial Britain."

We were pleased to find, immediately after these strong words were written, that others took an equally serious view of the situation after the war. The authors of "The Elements of Reconstruction," first in *The Times* and afterwards in book form, sounded an alarm quite as loud and equally vigorous in its expression. "Before us," the writers urge, "lies a period wherein we cannot afford to waste either time or energy, when indeed nervelessness, evasiveness, and dilatoriness mean the certain downfall of our Empire." That is a pretty good blow at the fool's paradise which we have endeavoured to expose in our articles on the defence of industry. Now we have further support in the highest of all quarters. The Prime Minister, in his great speech at the Guildhall, on 27th April, confirms what we said very distinctly and in much bolder language than we dare to use. "The future of this country," Mr. LLOYD GEORGE declares, "depends upon how much the politicians have learnt. I have heard of politicians who think that when the war is over the same old machinery will be set up, the same old methods applied, the same old notions adhered to. . . . . . When the war is over and reconstruction begins, I hope and trust and pray that we are not going to dive into the pigeon-holes of any party for dust-laden precedents and programmes. (Loud cheers.) Let us think out the best methods for ourselves in the face of searching facts we knew not of before the war. We are a thousand years older and wiser. The experience of generations has been crowded into just a few winters, and we should indeed be unworthy of the great destiny to which Providence has called this generation of men if we threw all that away for the sake of any formulas that were framed before the Flood. (Cheers.)"

This means, "let there be no more of the fool's paradise." To the writers of "The Elements of Reconstruction" and to the Prime Minister a new light has dawned. We have revealed in many reviews of the past the nature of that paradise: The positive refusal, on record in official documents, to recognize even the existence of British industries, however much they may suffer from the advent of a foreign State-aided monopoly. An equally positive refusal to give any reason for such a suicidal policy beyond a dogged and persistent iteration of the erroneous dogma that "duties must never be levied except for revenue purposes."

Now our warnings have received, for a third time, powerful support from high quarters. On Empire Day Sir EDWARD CARSON addressed, to a luncheon gathering of the British Empire Producers' Organization, some wise and weighty words. "We have found out," he says, "that we have been living in a fool's paradise in allowing these resources to be used for strengthening our enemy and in forging weapons to enable them to fight us here. The war will have been fought in vain if all that does not come to an end. It is not a question of victories in the field which will necessarily bring that about. You may throw up your hats and rejoice at a peace when the Allies march into Berlin, but unless you adopt new methods founded on the experience of the fire through which we are passing now, all the great victories of your Armies and your Fleets will have been achieved in vain. You must get rid above all things of the old catch-words. They will die very hard. I read occasional speeches of ministers or ex-ministers, and I find there is still a remnant of the feeling that we can get back to what they are pleased to call the old ideals of our party. God help us if we do." The speaker instances a few of the catch-words, including the most-favoured-nation clause. "How well that sounds," he cries; "what did it really mean? It meant that it was a combination of our enemies to make treaties which pleased them but left us at a disadvantage. I could quote to you innumerable instances which have occurred during the many years when I myself was a law officer of the Crown. Therefore I say, get rid of catch-words and come to reality."

All these utterances, so completely confirming our constant warnings, will greatly help the nation to arrive at just conclusions as to the true economic policy for placing our imperial industries on firm and unassailable foundations. The old school of *laissez-faire* must receive unanimous condemnation before we can start afresh on sound principles. That is the first and essential step towards the goal of reconstruction. The *doctrinaire* politicians were supposed to be disciples of ADAM SMITH. His great work, "The Wealth of Nations," appeared towards the end of the 18th century, the first, second, and third editions being published in 1776, 1778, and 1784. In those days no one dreamed of British industries being attacked by State-aided foreign competition, nor did ADAM SMITH see any vision of another form of competition which eventually hit the British farmer a fatal blow. Let us turn to ADAM SMITH's writings and quote a few of his really wise words. He did not, like our present teachers, ignore the importance of industry as the real source of strength and wealth. He would have been horrified at the idea of State-aided foreign competition destroying British industries, or of a superabundance of corn from the virgin soil of America compelling the British farmer to choose between producing wheat at a loss or leaving off growing it. He was a sufficiently good economist to know that if the consumer is allowed to enjoy the fleeting pleasure of buying below cost price, that indulgence must inevitably be paid for by a consequent reduction in production. The idea that we should ever be compelled to cease producing our own food never entered the head of ADAM SMITH. With ADAM SMITH freedom of *industry* was the bed rock of his economic science. With him, the important thing was "industry," not "trade." On the other hand, with the man of the present day, who boasts so loudly that he is "a convinced Free Trader," industry is of no consequence—as the Lords of the Treasury, in 1876, so naively admitted. The following is ADAM SMITH's doctrine, which the Editor of the 1904 edition regards as "really the text of the polemical portion of the *Wealth of Nations.*"

"The natural effort of every individual to better his own condition, *when suffered to exert itself with freedom and security*, is so powerful a principle that it is alone, and without any assistance, not only capable of carrying on the society to wealth and prosperity, but of surmounting a hundred impertinent obstructions with which the folly of human laws too often encumbers its operations; though the effect of these obstructions is always more or less either to *encroach upon its freedom or to diminish its security*. In Great Britain industry is perfectly secure; and though it is far from being perfectly free it is as free or freer than in any other part of Europe."[1] (The italics are ours.)

The meaning of this passage cannot be mistaken. *Industry* is the one and only "effort" to which ADAM SMITH is referring, and which, in his opinion, is alone "capable of carrying on the society to wealth and prosperity." The *doctrinaire* economist of to-day takes exactly the opposite view. He tells us, in dogmatic tones, that the only cause of our wealth and prosperity is free importation of all goods, under whatever circumstances they may be produced—and if sold below the cost of production, so much the better. That is exactly equivalent to saying, "perish our industries so long as we can buy cheap."

Secondly, ADAM SMITH, in 1784, was not aware that goods could be produced abroad, under various systems of State-aided production, in such a way as to enable the producer to export below cost price and yet make a large profit on his total outturn. He therefore refers to our industry in those days as being enabled "to exert itself with freedom and security." This, again, is exactly the reverse of our industrial position during the last sixty years. The Government of this country persistently declared that it was no business of theirs to see that British industries were enabled "to exert themselves with freedom and security." On the contrary, they most severely pointed out that any such duty was contrary to their economic principles. They emphatically disclaimed any interest in or responsibility for the freedom and security of the industries of this country, and always implied that their only desire was that foreign commodities, at the lowest possible (or impossible) price, should form the staple supply for the British consumer.

Thirdly, ADAM SMITH refers to the "folly of human laws" which have the effect on British industry "either to encroach upon its freedom or to diminish its security." Of course we know the kind of "impertinent obstructions" to which ADAM SMITH referred. But if he were living now he would, we are sure, agree with us in saying that the folly of what is now proudly called "our whole system of commercial policy" or "the whole code of the commercial legislation of this country,"[2] is at present the "impertinent obstruction" which British industries must now insist upon surmounting, because it "encroaches upon their freedom and diminishes their security."

Lastly, ADAM SMITH concludes this important passage, which the editor of his most recent edition regards as "really the text of the polemical portion of the *Wealth of Nations*," with these significant words, "In Great Britain industry is perfectly secure." What would he say to-day?

The fact is that there is no such thing, at present, as a "Science of Political Economy," BONAMY PRICE said so many years ago. The discussions over the sugar bounty question have thoroughly exposed this fact. The opponents of any remedy for such a form of foreign State-aided competition had to acknowledge themselves beaten on the scientific argument, so they fell back on the very simple cry of cheapness. Let us see how far that alternative stood the test of argument and facts.

---

[1] "An Inquiry into the Nature and Causes of the Wealth of Nations," by ADAM SMITH. Edited, with an Introduction, by EDWIN CANNAN, M.A., LL.D 1904 Vol II, page 43

[2] *Commercial, No. 22* (1879), page 11.

A distinguished Professor of Political Economy, about forty years ago, thought he would go into Parliament and teach them the true science. At one of his big election meetings a voice cried out: "What about the sugar bounties?" To which he promptly replied, with the Political but not Economic instinct,—striking the palm of his right hand with his left fist to give emphasis to his declaration—"I will never consent to tax the food of the people." There stood the man of science suddenly converted into the party politician. As a man of science he knew that levying a duty on sugar receiving a bounty is not taxing the food of the people but merely removing the bounty for the benefit of all the taxpayers, whether consumers or not, and thus restoring freedom of competition in the sugar industry, without which the consumer, as we have often shown, is seriously injured. When competition ceases, production is reduced, prices rise, and the consumer suffers. That is what he ought to have explained to the heckler. He had not the courage; the party cry was too tempting and he gave way to it.

What did COBDEN say? "We do not seek free trade in corn primarily for the purpose of purchasing it at a cheaper money rate; we require it at the natural price of the world's market." That is, the price based on the cost of production. He did not anticipate what would happen fifty years after he spoke those words. In the four years 1842-5, just before the abolition of the Corn Laws, the average price of wheat was 52 shillings and 4·25 pence per quarter, and the average price of the quartern loaf was 8·25 pence. After the abolition of the Corn Laws, for the 27 years ending 1875, the average price of wheat was 52 shillings and 4·74 pence per quarter, and the average price of the 4 lb. loaf was 8·32 pence. So COBDEN was right; there was no cheapness as the result of his abolition of the Corn Laws. But what he did not anticipate was the production on a vast scale throughout the virgin soil of Western America of wheat which came over and was sold at prices far below the natural cost of production in Great Britain. He and his colleagues would never have tolerated such a situation. They would have appreciated the importance of maintaining our home production of corn and would have acted accordingly. There is no doubt about it. Look at the figures. In 1877 the average price of wheat was 57 shillings per quarter. In 1894 the average price was 23 shillings. In that year at one time it touched and even went below 18 shillings. What did our politicians, political economists, and *doctrinaires* do? Nothing. What was the result? Our wheat acreage fell from 3,500,000 in 1875 to 1,500,000 in 1900. This was the happy result of *laissez-faire*.

What did Mr. GLADSTONE say about cheapness thirty years after COBDEN? These are his words, they ought to be marked and digested. "I cannot regard with favour any cheapness which is produced by means of the concealed subsidies of a foreign State to a particular industry, and with the effect of crippling and distressing capitalists and workmen engaged in a lawful branch of British trade." In a subsequent statement he added:—"Some people attempted to say that the consumers got the benefit, but he did not think so. He did not think that any benefit founded on inequality and injustice could be a permanent benefit to the consumer." But the "Free Trade" party were too strong for him and he dared not act.

One more instance of this craving for cheapness. The year before last things began to look serious with regard to our food supplies. Lord Milner's committee was appointed, and did its work well and quickly. The farmer was to be guaranteed a minimum price in order to stimulate increased production. The matter was urgent, but weeks, and months, and years passed, and nothing was done. And why? *The Observer* tells us why. "This supremely necessary and urgent measure was banned by some of Mr. Asquith's colleagues, in the abstract name of Free Trade, though, as we have shown, it might have been happily defended on the authority of all the Fathers of Free Trade."

No more corn was grown, and now we are in a greater quandary than ever, and all because, thirty years ago, we sat still and did nothing, while the British farmer was compelled to give up growing wheat because it was being forced on the market far below cost price.

These are the happy results of sham Free Trade. And yet we are told, under the heading of "Free Traders and Imperial Preference," that the Parliamentary Free Trade Committee are considering their attitude, are discussing the position, and are recognizing "the importance of avoiding a false move in a hurry."

Impurities in Raw Sugar.

In answer to questions put in the House of Commons recently regarding the advisability of placing on the market a number of sugars of the semi-refined or direct consumption class instead of passing them through the refineries with the consequent labour involved, the Food Controller's Department has alleged that *the bulk of the raw sugar* received in this country at the present day is not fit for consumption in the raw state.

On May 6th Sir Henry Dalziel asked the Prime Minister whether, with a view to economizing time, labour, and material, and also the saving of cost, sugar at present sent to refineries would in future be offered for sale to the public in its raw state under control of the Sugar Commission , and, if not, would he state what were the objections to this course being adoped ?

Captain Bathurst, who replied, said the Food Controller had already considered this proposal very carefully, and having regard to the physical conditions in which the bulk of raw sugar was received in this country and the high percentage of impurity contained in it he was not prepared, as at present advised, to adopt the suggestion in the question. He might add in regard to impurity that sand and clay and specimens of the sugar louse were contained in the raw sugar. The matter had been most impartially investigated by the Ministry of Food, including, among others, himself. He added that the recent reduction in sugar was preferable to putting an impure product on the market, which might seriously affect the health of the people.

Again, on May 25th, the same M.P. questioning on the same subject was told that "a certain quantity of American granulated sugar has been purchased to meet the requirements of fruit preserving, for which Cuban raw sugar is quite unsuitable. Supplies of Cuban raw sugar to wholesale distributors have been refused because, as has already been explained, the impurities in sugar of that description render it unsuitable for general consumption as a grocery sugar. It contains iron, and if strawberry jam were made with it, it would turn it black."

Sir H. Dalziel then asked the Parliamentary Secretary to the Ministry of Food whether the Sugar Commission in their dealings with sugar planters always asked them to supply low grades, i.e., refinery sugar polarizing 96 per cent. ; whether he was aware that such action was largely influenced by the refiners, who were anxious to keep their refineries open , and whether sugar planters, if they had been asked to supply a higher-grade sugar which could be sold direct to the public, could equally well supply it ?

Captain Bathurst : The Sugar Commission do not usually deal direct with planters, nor does the Commission influence in any way the character of the sugar which planters produce. That has been determined long ago by the methods practised and the plant employed in treating the juice of the sugar cane, and it does not lie with the Sugar Commission to alter it. The influence of the refiners does not affect the policy of the Commission.

Sir H. DALZIEL next asked the Parliamentary Secretary to the Ministry of Food, in reference to a recent statement on behalf of the Department regarding impurities in raw Cuban and Java centrifugal sugars, would he say whether the refiners had from time to time melted raws the polariscope test of which was 97 to 98 degrees, and if the alleged high percentage of impurities was overstated, and would he produce copies of the analysis of sugars melted during the last three months; and would he say whether the polariscope test of Cuban raws now being refined was higher than that of the Jamaica and Demerara raws which the Royal Commission allocated for grocery use?

Captain BATHURST: The question appears to be based on the supposition that the polariscope test of sugar is indicative of the impurities that may be mixed with the sugar. This, however, is not the case, as sugars showing a high polariscope reading may contain a large percentage of impurities, rendering them unfit for direct human consumption. Conversely, sugars with a low polariscope reading may be relatively free from such impurities. There appears, therefore, to be no reason for furnishing the analyses asked for, as it would involve a large amount of unnecessary labour.

Sir H. DALZIEL: Having regard to the fact that the Hon. and gallant gentleman the other day made some serious suggestions about the impurities of this sugar, why should he not be able to give up the analysis which was made previously when I asked my question?

Captain BATHURST: Because there would be nothing gained if the analysis desired is one which will result from the polariscope test. The polariscope is effective in determining the amount of sucrose in the sugar itself—that is, the amount of saccharine matter—but it would not be effective in making any determination with regard to such adulterants as beetles, lice, or lizards. I should like to invite the Right Hon. gentleman to come and see the collection now to be found in the Sugar Commission Museum. As a zoologist it would interest him.

These statements on the part of the Food Controller have occasioned some surprise not to say amusement in sugar dealing circles, especially as regards the sugar louse, which pest has been virtually unknown for many years past, save possibly in certain low grade sugars, such as Ilo-Ilo, which normally are never put into consumption at all. Actually, however, certain quantities of this last class were to be seen on the tables of teashops in London not many weeks ago, being part of a parcel which was imported for brewing purposes, but was, owing to the favourable price ruling, placed on the ordinary sugar market.

No definition of the sugar said to be infected with the sugar louse (the one-time much boomed *Acarus sacchari*) was given in the first of the above answers, so the public were unfairly left to assume that any of the excellent raw cane sugars cured in the centrifugals, such as Java centrifugals or other types of plantation whites or direct consumption sugars, which are necessarily not as pure as refined, were indicted. It is hard to avoid the conclusion that the results of the analysis of some low grade sugar, such as the above mentioned Ilo-Ilo, have been made the basis of this really unwarranted criticism of modern raw cane sugars in general.

There *was* a time when raw cane sugar did contain a percentage of impurities. In the old days before the centrifugal machine was introduced into the sugar factory, the process of "claying" in barrels to remove the molasses adhering to the grain was followed. This produced a very low grade of sugar, which was dark brown in colour if not often almost black. Such a product besides containing much uncrystallizable sugar had a very high content of mineral matter, a proportion of which might contain more or less clay. This was the sugar sent to the refineries of Greenock, Liverpool, and London. It was a damp product and formed an excellent medium for the propagation of the sugar louse, and it was a favourite exercise for the youthful microscopist of those days to isolate this *Acarus* *sacchari* by floating the insect out on water and afterwards submitting it to examination.

But now-a-days, as every grocer's assistant should be able to inform the Food Controller and his Department, the amount of these crudely manufactured sugars imported into this country is comparatively small compared with the whole. Since the advent of the centrifugal machine the constant tendency (aided by improved methods of clarification) has been to produce a better and yet better sugar, and now instead of dark West Indian, Philippine, and such like grades, we have sugar of a very different nature from Java, Cuba and other countries. Captain BATHURST should find most of these qualities clean and free from any appreciable quantity of clay, and he would search in them in vain for the sugar louse. Inquiry in fact would show him that a proportion does pass direct into consumption while some of the rest might very well in these days do so, though it is sent instead through the refineries whose capacity is already more or less overtaxed.

On the other hand, the set of questions and answers of May 25th, as given above, specifies a particular origin of sugar indicted, viz., Cuban, and we take it that Cuban centrifugals are referred to. We cannot of course say offhand whether all the imports of Cuban sugar recently have been up to the usual standard; and to judge by Captain Bathurst's replies there would appear to be a certain proportion which have not been turned out in the Cuban centrals with the customary care, in other words there is some indication of scamped work amid dirty surroundings and possibly of bagging in contaminated bags. But we must refuse to believe at this stage of the evidence that the contamination is at all widespread or that the general run of Cuban centrifugals contain impurities which render them unsuitable for consumption as a grocery sugar. That they are not exactly suitable for fruit preserving may be admitted, but that for reasons apart from the question of alleged physical impurities. The practice of most Cuban sugar factories is normally of a high order, and if the output is not so pure as is that of the general run of Java factories, it is not sufficiently inferior to warrant it being classified as a sugar fit only for refinery purposes. As for the content of iron, this can surely only be due to the exceptional presence of some factory plant scale, and can hardly be deemed a general ingredient, unless indeed it is the outcome of using inferior apparatus in some of the new factories.

We have ventured to question the accuracy of these criticisms of the general run of raw cane sugars coming into this country, because they are utterly at variance with the experience of the trade for many years past. The two principal classes of sugar upon which we have mainly had to fall back the last two years have been Javas and Cubas, and both of these are high grade, especially the former. It is true we are no longer officially informed of the sources of our sugar supply, so cannot tell with any certainty the range of likely culprits. It is known fairly well, however, that we are depending chiefly on supplies from Cuba, the difficulty of securing shipping to bring Java or other sugar to this country being a considerable bar to getting supplies from other sources. If the charge against our raw sugar supplies—that *the bulk of them contain a high percentage of physical impurities*—is really well founded, then it can only arise from the fact that the high standard of production normally observed in the raw sugar centrals has been reduced during the past season and a more or less considerable quantity of dirty sugar has been offered to and bought by the Royal Commission on Sugar Supplies. If this is not so, then those responsible for exporting the sugar ought in their own interests to vindicate the quality of their recent outputs, otherwise their sugar will suffer an inevitable decline in the estimation of the consumer.

Notes on American Sugar Production.

(From our American Correspondent.)

Since the date of my last previous letter events of far-reaching importance to the two great English-speaking nations on opposite sides of the Atlantic have occurred. From its position as the one great power maintaining a neutral position in the world conflict the United States has definitely taken its stand by the side of those who are fighting, in President Wilson's phrase, to "make the world safe for Democracy."

It must be said that the attitude of the majority of Americans towards this development is one of relief—relief that the strain of waiting upon a result that has long been regarded by most of us as inevitable is at an end and that it is possible to aid in a material and practical way the cause in which our sympathies long since were enlisted.

This feeling has manifested itself in many striking ways, not only in the outburst of colour in which British and French flags everywhere appear side by side with the Stars and Stripes but also in the enthusiasm with which Americans of every class are endeavouring to make their energies count in some practical way towards an effective contribution by the United States to the cause of freedom.

This may be a little remote as an introduction to a discussion of the sugar situation, but this is a time when consideration of ordinary affairs is submerged by broader and more genuinely important interests. This is true of the sugar industry as well as of others. In the long run it is probably true also that the participation of the United States in the war is likely to exercise a more important influence upon the American sugar industry than any of the other factors that have come into play within the recent past.

So far as the immediate situation is concerned there has been no lack of interesting developments in the sugar world. It cannot be said that the changed status of the United States toward the war has exercised any very marked influence upon the market thus far, but the market has been exceedingly active and prices have risen more or less steadily throughout the month, the quotations for 96° test centrifugals having advanced approximately three-quarters of a cent a pound and refined one cent a pound since the corresponding date last month

For this condition the further decline in the estimated volume of available supplies for the current year is primarily responsible. Since my letter of last month the Cuban insurrection has come to an end, at least as an organized movement, and the MENOCAL government is in full command of the situation. The destruction of cane, however, and particularly the extensive damage to the railway lines, has rendered it impossible for many of the mills to approach the output anticipated at the beginning of the season. Within the past week heavy rains have fallen over a large part of the Island and if these continue, as they are likely to do, it will be impossible to work up a considerable part of the cane that is still standing.

Under these circumstances a further reduction in the estimate of the Cuban crop has been made necessary, and the prospective outturn is now placed by *Facts about Sugar* at 2,500,000 tons, a figure which is accepted by most of the statistical authorities, although one or two still adhere to a slightly higher figure. This is a decline of a round million tons from the estimates of last autumn. Considering the extent to which both American and European markets are dependent upon Cuba it is sufficient explanation of the rise in prices that has taken place since the first of the year and which has been foreshadowed in my previous correspondence.

The Cuban crop is not the only one supplying this market to which it has been necessary to apply a sharp revision of earlier estimates. The probable production of Porto Rico is now placed by J. RUIZ SOLER, Secretary of the Porto Rican Sugar Growers' Association, at only 430,000 tons instead of the 460,000 tons looked forward to earlier in the season. Within the past week the Department of Agriculture has made public its figures on the beetroot production, which it gives as 732,730 tons, nearly 50,000 tons less than the yield of the 1915-16 season. As the greater part of this beet sugar has entered into consumption, the decline does not materially affect the existing situation. The Hawaiian output is holding closely to early estimates, and the Philippine crop is somewhat larger than reports at the beginning of the season had led the trade to expect. Owing to difficulties of transport not much more than half of this Philippine sugar is likely to reach this market. The remainder will go to satisfy demands in the Far East.

Since the formal recognition by Congress of the existence of a "state of war" between the United States and Germany discussion has turned to two channels of practical concern to the sugar industry. One of these is the provision of revenue to meet the expenses of the war. The other is the possibility of the adoption of regulations to control prices and the distribution of supplies.

It is the announced purpose of the Government to raise nearly $2,000,000,000 of additional revenue during the coming year by taxes of various kinds, and among measures under consideration is one for an excise tax on sugar of one cent a pound which it is estimated would yield about $92,000,000. If imposed this tax will apply alike to sugar of domestic and of foreign origin. It would impose no particular hardship upon producers or refiners, as the latter already have issued notices to the trade that any such tax will be added to list prices. It will be paid therefore by the consumer. By that very fact it would tend of course to cut down consumption.

Proposals for governmental regulation of prices and control of the distribution of supplies thus far are only tentative. It is doubtful whether it will be necessary in any case to apply such measures to sugar, although of course it cannot be foretold what procedure later events may dictate.

According to a statement recently issued by the United States Department of Agriculture, the sugar production of Hawaii for the year ended 30th September, 1916, was 592,763 short tons, or 53,237 tons less than in the previous year. The area harvested was 115,419 acres, or 2,219 more than in 1915, but a lower yield of cane per acre and a lower average of sugar per ton of cane made the sugar crop of 1916 less than that of the preceding year. The total area in cane in 1916 was 246,332 acres, an increase of 6,532 acres over 1915.

Mr. W. W. GOODALE, Manager of the Waialua Agricultural Co., Hawaii, reports the following comparisons of cane values for the 1916 crop. *Yellow Caledonia*, 80·4 tons of cane, and 9·28 tons of sugar per acre, the sucrose being 12·95 per cent. *Lahaina*, 55·55 tons of cane, and 8·98 tons of sugar per acre, the sucrose content being 16·95 per cent. *Demerara 117*, 72·04 tons of cane, and 8·71 tons of sugar per acre, the sucrose content being 13·36 per cent. On the basis of these figures, a ton of sugar made from Lahaina cane costs only 71·47 per cent. as much as a ton from the Yellow Caledonia variety.

The Sugar Supply of the Empire.

A long and interesting paper on "The Sugar Supply of the Empire, its Production and Distribution" was read before the London School of Economics last month by Mr. C. SANDBACH PARKER, Chairman of the British Empire Producers' Association, to an audience which included a large number of those interested in the sugar industry.

Dealing first with the period prior to the war, the speaker sketched the history of our colonial industry, pointing out that from 1660 to 1854 British grown sugar was admitted on preferential terms into this country; from 1787 onwards there was a preference over foreign sugar of 2d. per lb. Cobden's free trade policy however finally abolished all differential import duties. He then gave detailed statistics of the progress of sugar in various countries during the last fifty years, including the rise of the bounty system, the development of Cuba and Java, the vicissitudes of the British Colonial cane industry, and the prolonged unwillingness of successive British Governments to do anything for the West Indian sugar production, save to allow Canada to give them for ten years a preference which probably saved them from extinction. But he pointed out that a lack of security that this latter preference would continue and the small requirements of that country were a bar to any extension in the West Indian sugar industry, though it gave them a market at a time when no other market was available; and he drew the conclusion that had England extended similar treatment to British grown sugar such as America gave to her possessions a rapid development would have taken place in the West Indies and all other cane growing countries of the Empire which would have saved the nation during the present war a colossal sum.

At the outbreak of the war, our annual consumption, said Mr. PARKER, was over 1,700,000 tons; of this total 400,000 tons went to the sugar-using trades, 100,000 tons to the brewing industry, while the rest, equalling about 58 lbs. per head of the population, was directly consumed. This worked out at an allowance of 1·12 lbs. per head per week.

The action of the Royal Commission on Sugar Supplies in practically commandeering the available sugar in our Crown colonies in the autumn of 1914 came in for some criticism by Mr. PARKER. He pointed out that some of this sugar was compulsorily bought at 17s. per cwt. f.o.b. whereas similar sugar sold to Canada about the same time fetched as much as 21s. 8d. f.o.b.

Dealing with after war conditions, Mr. PARKER thought that for a long time to come European beet areas would have little if any sugar to export; the surplus productions of American colonies and Cuba would to some extent fulfil the immediate requirements and so control the price. But he urged that to transfer our dependence for our sugar supply from Germany and Austria to Cuba or Java or any other foreign country would be to jump from the frying pan into the fire National security demands that we shall never again allow ourselves to be found in the position of dependence on foreign supplies; the British Empire must develop its own production. Then Mr PARKER went on to emphasize repeatedly that the numerous cases cited of lack of progress in sugar production amongst our existing sources were all due in the main to want of security that capital invested would be able to reap a reasonable return when faced by all the existing competition of bounties and preferences in other countries likewise producing sugar. Nor can any development take place within the Empire even now unless security of market can be assured for a reasonable term of years.

We understand that this Paper is being printed as one of a series of lectures on the staple industries of the Empire by the London University authorities to be shortly issued in book form under the title of "Staple Industries of the Empire." As it contains a very useful collection of statistics on the sugar industry all over the world, in collating which Mr. PARKER must have put himself to no little trouble, the publication in permanent form of this paper will be opportune.

Studies in Cane Sugar Manufacture.[1]

INVESTIGATIONS ON PROCESSES IN WHICH THE TOTAL CLARIFIED JUICE IS PASSED THROUGH FILTER-PRESSES

By CHARLES FRIBOURG

III

ANALYSIS OF SULPHI-DEFECATION AND SULPHI-PHOSPHATATION SCUMS.

In our article of 1913-14 a rather detailed analysis was given of sulphi-defecation scums originating from "Factory A." These scums contained (calculated on the dry matter) 2·70 per cent. of phosphoric acid and 1·20 per cent. of nitrogen. Here is a full analysis of sulphi-defecation scums from "Factory B" (taken at about the same time as the experiments described previously):—

	Calculated on the dry matter per cent	
Organic matter —		
Sugar	24·66	87·00 per cent.
Crude Wax	12·10	
Cellulose	6·30	
Nitrogenous matter	15·70	
Other organic matter	28·24	
Mineral matter —		
Sand	0·65	13·00 per cent.
Combined silica	2·27	
Calcium sulphate	0·80	
Calcium phosphate	4·00	
Calcium combined with organic acids	2·70	
Magnesium oxide	0·02	
Ferric oxide	0·70	
Manganese oxide	0·30	
Undetermined matter (alumina, alkalis, carbon dioxide, etc.)	1·56	
	100·00	
Total nitrogen	2·51	
Total phosphoric acid	1·83	

Analyses here follow of scums (dry) originating from six experiments made in Factories A and B, described in preceding pages (that is, when "Phosphogelose" or dicalcium phosphate was used sometimes with the addition of kieselguhr):—

---

[1] See also *I.S.J.*, 1917, 125-130, 162-167, and 223-226

(Results as percentages on the dry matter.)

	Factory A.						Factory B.					
	Dicalcium Phosphate, 2 grms , Kieselguhr, 3 grms per litre		"Phosphogelose," 2 2; Kieselguhr, 2 2grms per litre		"Phosphogelose" alone, 6 grms per litre		"Phosphogelose" alone, 6 0 grms per litre		"Phosphogelose" alone, 5 0 grms per litre		"Phosphogelose" 2 grms ; Kieselguhr, 2 5grms per litre.	
Organic matter.—												
Sugar	18·9		23·20		15·60		16·70		48 90		17·50	
Crude wax..	4·6		4·92		3·96		2·81		4 21		3·23	
Cellulose	5 45	51 83	7 52	59 60	9·20	50 79	8·60	50·66	8·10	59·60	6·59	55·53
Nitrogenous matter..	8·69		7 75		7·25		7·50		8·75		7 37	
Organic matter and combined water .	14·19		16·21		14·78		15·05		15·09		20·84	
Mineral matter:—												
Sand and silica	22·37		17·70		9·67		10·06		9·62		21·72	
Sulphuric acid	1 66		1 78		1·80		2·00		1·70		2·47	
Phosphoric acid	8·54		7·16		14·04		14·32		13 01		5·52	
Lime	12·37	48 17	10·62	40·40	19·52	49 21	19·31	49·31	17·00	44 95	10·75	44·77
Ferric oxide	1 00		1·00		0·70		0·85		0·77		1 14	
Undetermined matter (manganese, alumina, alkalis, etc. .. .	2·23		2·15		3·48		2 80		2·85		2·87	
	100·00		100·00		100 00		100 00		100 00		100·00	
Total nitrogen	1·39		1·24		1·16		1 20		1·10		1·18	
Phosphoric acid soluble in citrate ..	6 54		4·34		9·47		8·90		8·90		5·19	

The following facts may be stated from these results, taking into account also those already indicated:—

(1) The weight of dry scums obtained per 1000 litres of juice with ordinary sulphi-defecation (without kieselguhr) is about 6 to 8 kg.; while with the use of kieselguhr and "Phospho-gelose" or dicalcium phosphate a weight of 11 to 12 kg. is attained.

(2) The quantity of nitrogen contained in scums produced by phosphatation is less than with sulphi-defecation, the total amount of this constituent precipitated being distributed in a greater weight of scums.

(3) The proportion of phosphoric acid, which with ordinary defecation scums varies from 1·50 to 3 0 per cent., is increased with the use of phosphates; and, depending upon the amount employed, contents from 7 to 14 per cent. are then found. With the mixture of one part of dicalcium phosphate and two parts of kieselguhr, recommended by us, scums containing 6 to 8 per cent. of total phosphoric acid (in the dry state), a quite large part of which will be in a form soluble in ammonium citrate, will be obtained.

(4) All the phosphoric acid added as defecating agent (or almost all), as well as that normally contained in the juice, is recovered in the scums, which thus constitute an interesting fertilizer by reason of their content in phosphoric acid, nitrogenous matter, and lime.

INDUSTRIAL USE OF "PHOSPHO-GELOSE."

In 1914 we had the opportunity of employing "Phospho-gelose" in a large scale experiment in "Factory B", and this during a period of four weeks. This factory, equipped for working 300 tons in 24 hours, clarified its juice by sulphi-defecation with treatment of the scums and muddy juices according to the procedure already announced. It possessed a number of filter-presses (30 chambers of 60 × 65 cm., or 26 in. × 26 in.) as well as an automatic pump, sufficient for operating "Phospho-gelose" without modification. The purity of the juice, variable as in all cane sugar factories, averaged 82°, with extremes of 78° and 84°. Having only "Phospho-gelose" at hand, we were obliged to use 5-6 kg. per 1000 litres of juice, in order to have a sufficient quantity of kieselguhr present; which quantity might have been reduced had the "Phospho-gelose" had the composition recommended by us, namely one of phosphate and two of kieselguhr. The juice coming from the mills was sulphited in a Quarez apparatus, which raised the acidity from 0·20 to 0·70, that is, an increase of 0 50 grms. per litre. It was afterwards placed in liming vats, to which 12 litres of milk-of-lime of 10° Bé. per 10 hectolitres of juice were added, or about 1·20 grm. of lime (CaO) per litre. After mixing for some minutes, the limed juice was sent into ordinary defecators (without reheating), to which the "Phospho-gelose" in advance had been added at the rate of 6·0 kg. per 12 hectolitres (6 grms. per litre). Mixing was intimately effected, and there was a delay of a few minutes before commencing heating. Thus, defecation *in the cold* was carried out, which is very important when phosphates are used for the defecation of the juice, as will be concluded from numerous remarks which we have had occasion to make. Then the juice was raised to boiling point, always maintaining it in movement, and directly passed to the filter-presses by means of an automatic pump. The operation of the presses was very satisfactory, and when each had been filled, washing with warm water (about 200 litres for each press, giving 250 kg. of pressed scums) was effected. The filtered juices and wash-waters were immediately repassed into Philippe filters, which as a matter of fact was unnecessary as they were very bright, this being done only as a precaution in case a filter-cloth might have been holed or have been otherwise defective. The juice remaining in the Philippe filters was returned to the defecators, though sometimes it was sent directly to the filter-press feed tank. It may thus be seen how work is simplified.

A comparison of the work by means of chemical control may now be drawn. The average of the analyses effected during the two weeks preceding and of the two weeks following the four weeks of using "Phospho-gelose" have been taken.

	Sulphi-defecation.			*"Phospho-gelose."*		
	Sulphured Juice	Filtered Juice.	First Jet Masse-cuite.	Sulphured Juice.	Filtered Juice.	First Jet Masse-cuite.
Brix, by weight	19·47	19·78	93·50	19·50	18·68	93·30
,, by volume	21·05	21·41	—	21·08	20·13	—
Sugar, per 100 c c.	17·30	17·40	—	17·31	16·58	—
,, per 100 grms.	—	—	76·30	—	—	76·90
Purity	82·0	81·3	81·6	82·1	82·4	82·4
Glucose, per 100 c.c.	1·68	1·65	7·25	1·58	1·55	6·92
,, per 100 grms.	9·70	9·50	9·50	9·10	9·30	9·00
Ash	0·39	0·54	2·34	0·41	0·43	2·00
Saline ratio	44·30	32·20	32 50	42·20	38 58	38·40
Lime (CaO) per 100 of sugar	—	0·68	0·68	—	0·35	0·35
Reaction,[1] whether acid (+) or alkaline (—)	—0 670	+0·035	+0·011	—0·685	+0·018	+0 081

During the two periods considered the average composition of the juices put into process was practically identical, comparison being thus facilitated.

With the ordinary method of working, the Brix of the filtered juice was a little higher than that of the juice put into operation, in spite of a little water originating from the dilution of the thick scums and of a slight washing of the scums, this being due to a large extent to the evaporation taking place during elimination. This evaporation is costly, since it is effected with live steam and in the open air.

When working with "Phospho-gelose", on the other hand, there is no need to effect elimination, and the Brix of the filtered juice is about one degree less than that of the juice put into process, this being due in part to washing in the filter-presses, of which there are a greater number than in the ordinary process. It is only in the triple effect that evaporation takes place, that is to say, using the less costly exhaust vapour. After the juice has undergone defecation in the cold in the "Phospho-gelose" process, it may be raised to the desired temperature for hot defecation and filtration, solely by means of reheaters operating by exhaust steam, though a little live steam may be added, if necessary.

In ordinary working the purity was found to fall half a point, whereas with the "Phospho-gelose" there was an increase of 0·3°, so that between the two processes there is a difference of purity amounting to almost one point. The saline ratio referred to the juice before treatment fell 12 points in ordinary working, but only 4° with "Phospho-gelose." With sulphi-defecation, 0·68 of lime per 100 of sugar were found, and only 0·35 with phosphation, that is, a rather marked difference, which explains the improved filtration and the better working alike in the evaporation and boiling of the different jets.

Liming in the ordinary procedure is so regulated as to leave a slight alkalinity of the filtered juice, varying from neutrality to 0·100 per litre, according to the factory and consequently the juice to be treated. A slight alkalinity is thus retained as far as working up the low products. In the case of using "Phospho-gelose", different procedures were tried in order to have filtered juice passing to evaporation either alkaline, or neutral, or again slightly acid. We consider that in the majority of cases, one may work between neutrality and an alkalinity of 0·500. With certain canes, in order not to diminish the rapidity of filtration, it would be well to have a very slight acidity, but not more than 0·05. During the period considered, on the average there was a slight alkalinity, namely 0·018, though often it was 0·05.

---

[1] The reaction in the case of the juice is given in grms. per litre, but in that of the massecuites in grms. per 100 c.c.

The lime to be added in cold defecation may at first be calculated on a lower value than the theoretical one, but it should rather be based on practice, and it should be higher as the quantity of phosphate used per litre is increased, which, in fact, was what was done.

One may observe a loss of alkalinity as far as concentration, firstly, between the defecated juice and that raised to ebullition, the action of the phosphates being completed during heating, then during heating, and then again during filtration through the presses and the Philippes. After a very little time, one soon knows exactly to which alkalinity in the cold one must adjust the liming in any particular factory, in order to give the syrups and massecuites a certain predetermined alkalinity.

Finally, it may be mentioned that it has been possible to notice a marked improvement in the quality of the sugars obtained, a matter most important in factories making white sugar, as was the case.

In conclusion, an analysis of factory scums, carried out on a sample taken during working with "Phospho-gelose" is given. About 28 kg. of scums were produced, containing 55-60 per cent. of water, and originating from 1000 litres of juice, that is, 11-12 kg. of dry scums per 1000 litres of juice.

Organic matter —	Per cent	
Sugar	15·90	54·00
Crude wax	3·02	
Cellulose	7·96	
Nitrogenous matter	8·37	
Other organic matter	18·75	
Mineral matter :—		
Sand and silica	9·30	46·00
Sulphuric acid	2·20	
Phosphoric acid	13·25	
Lime	18·06	
Ferric oxide	0·76	
Undetermined	2·43	
	100·00	
Total phosphoric acid	1·34	
Phosphoric acid soluble in citrate	7·98	

These scums were produced when working with 5-6 grms. of "Phospho-gelose" per litre of juice, and they show an analogous composition to that of the scums obtained in the small scale experiments with a filter-press under the same conditions.

Later, we hope to give the results of other studies in the use of "Phospho-gelose," modified according to our recommendations, that is to say, containing a greater proportion of kieselguhr.

The "Frothy Fermentation" of Second Jet Massecuites in Beet Sugar Factories.

By RENÉ GILLET.

The phenomenon of "frothy fermentation," which has been studied by some of the most eminent chemists, has now almost completely disappeared from the sugar factory, being encountered only in certain rare cases. These, however, have generally been easily overcome since the researches of Herzfeld, who established that when "frothy fermentation" occurs the massecuites give an acid reaction to phenolphthalein, but also an alkaline indication towards rosolic acid; whereas massecuites which have a real alkalinity to phenolphthalein do not give trouble in this way.

But though the means of prevention against this malady of the old sugar manufacturers is clear and well known, that is, always and everywhere to maintain a real phenolphthalein alkalinity, this is not so with the scientific explanation of the phenomenon itself, since different writers on the matter have advanced very opposite theories of greater or less probability, each nevertheless having many obscure and doubtful points. However, all retain till the present time some element of truth, as indeed is so with every chemical phenomenon, the scientific cause of which yet remains unknown.

These several theories may be divided into two classes. (1) The micro-biological; and (2) the purely chemical. The first states that the phenomenon is to be attributed to a true frothy fermentation caused by thermophylic micro-organisms, and was supported for a time by Herzfeld[1] and by Lafar, though latterly these two workers appear to have abandoned it in favour of the chemical explanation. Laxa, as well as Maassen, still adheres to the micro-biological theory.[2]

The purely chemical theory establishes that the phenomenon is produced by the liberation of carbon dioxide gas, resulting from chemical reactions, either between the different non-sugar products, or else between the invert sugar and the organic non-sugar. It was first advanced by Claassen, who always opposed the micro-biological theory, without, it would seem, suggesting any chemical explanation.[3] Its other adherents are von Lippmann, Prinsen Geerligs, Herzfeld, Lafar, and Kraisy.

The exact chemical theory most favoured at the present time is that of Lafar and Kraisy. According to these writers,[4] the phenomenon would appear to be due particularly to the combination of the invert sugar with the amino-acids of the organic non-sugar (glutamic and aspartic acids), a reaction that gives rise to the disgagement of carbonic acid gas, which on being produced at first remains in a supersaturated state in the massecuite, only to be liberated between 80° and 65° C., owing to crystallization destroying the condition of supersaturation.

Having had the opportunity of encountering a case of "frothy fermentation" in some second jet massecuites, the writer profited by it in endeavouring to study the point whether the micro-biological theory is impossible and completely to be abandoned.

Some very valuable information relating to this kind of investigation was found in Mr. Saillard's papers on sugar factory micro-biology, to which during the course of this article the writer will have occasion to refer.

---

[1] *Die deutsche Zuckerindustrie*, 1914

[2] *Wochenschrift*, 1905.

[3] *Centralblatt*, 1905

[4] *I.S.J.*, 1914, 184, 230.

Culture Media employed.

(1) *Ordinary neutralized Liebig broth or bouillon, containing sugar.*—Extract of meat, 5 grms.; peptone, 10 grms.; salt, 5 grms.; and sucrose, 40 grms. per litre.

(2) *Neutralized extract of yeast broth.*—(*a*) In addition to the yeast extract, also contained 10 per cent. of sucrose; (*b*) in addition contained 0·5 per cent. of asparagin; (*c*) contained 10 per cent. of invert sugar; and (*d*) besides the invert sugar, also contained 0·5 grm. of asparagin. A part of each of these yeast media was preserved neutral, while the other was made slightly alkaline with N/10 sodium hydroxide after sterilization, in order to have 0·015 alkalinity (in terms of calcium oxide, using phenolphthalein); while the others were slightly acidified by acetic acid diluted with sterilized water.

(3) *Broth used by Saillard.*—Sugar, 80 grms.; ammonium phosphate, 0·4 grm.; magnesium sulphate, 0·4 grm.; potassium phosphate, 0·2 grm.; potassium nitrate, 0·2 grm.; and dry peptone, 2·5 grms.

(4) *Broth suitable for butyric bacteria.*—(*a*) Sucrose, 6·0 grms.; ammonium phosphate, 0·15 grm.; calcium carbonate, 5·0 grms.; water, 200 c.c.; (*b*) the same medium, but with invert sugar and 0·5 grm. of asparagin.

It is unnecessary to insist upon the sterilization of these different media, as well as upon the precautions to take in inoculation and incubation, matters that are inherent and indispensable to all bacteriological researches.

Inoculation and Incubation.—By means of a long iron rod sterilized immediately before use, and enveloped up to the moment of taking the sample with sterilized paper, a sample of the massecuite in "frothy fermentation" was taken through the man-hole above the mixer. It was introduced aseptically into a sterilized vessel plugged with cotton wool, taken to the laboratory, and forthwith used for the inoculation of the different cultures, these broths previous to inoculation being raised some to 68°- 70° C. and others to 40° C. The point that there was no actual cooling of the mass, and that it was directly inoculated at high temperature, in part, at any rate, must be insisted upon. Three experiments on different days, and from different mixers, were carried out in the same manner. The temperature of the massecuite, that is to say, that indicated by the mixer thermometer, was 75° C. in the first, 80° C. in the second, and 73° C. in the third experiment.

Results obtained on Inoculation.

At the temperature of 68°-70° C.

(1) *Extract of yeast medium.*—(*a*) After 10 hours it was observed that the yeast broths that contained invert sugar and had been acidified with acetic acid, as well as those containing asparagin, became cloudy; while after 18 hours a skin was formed on the surface, which thickened, striated, and swelled at different points, while evolving gas. Moreover, the skin lined the glass below the liquid. (*b*) The yeast broths with invert sugar in neutral solution both with and without asparagine showed the same development, but only after 24 hours. (*c*) The yeast broth with sucrose alone, or with sucrose and asparagin in acid solution showed very slightly marked signs of development only after the third or fourth day. (*d*) The same yeast broths as in (*c*) but in neutral medium developed only very difficultly, and this with only two out of six, the rest remaining sterile. (*e*) All the alkaline culture broths remained sterile.

(2) *Liebig broths.*—There was development in all the flasks, which was less pronounced than in the case of the yeast extract broths.

(3) *Broth used by Saillard.*—(*a*) In the broths for butyric micro-organisms there was no development. (*b*) With the broth containing invert sugar the development was very slow. (*c*) With the medium containing sucrose there was no development.

At the temperature of 40° C.

(1) *Extract of yeast broth.*—After more or less time there was development in all the flasks, even in those containing the alkaline media.

(2) *Liebig and Saillard media.*—In these, including the broth for butyric micro-organisms, there was in all development.

MICROSCOPICAL EXAMINATION OF THE CULTURES.

Organisms developed at 68°-70° C.

Direct incubation of the massecuite at 70° C. gave a pure culture, consisting of bacilli having a length of 2μ on the average, the ends of which were rounded. They were animated by a rapid oscillatory movement, which, however, diminished in intensity after being some time under the microscope. The organism is gram-negative. Its death point is about 75° C.

Organisms developed at 40° C.

Here the culture is not pure, and two micro-organisms in particular were distinguishable. The first was that described above; and the other was a bacillus of about 1μ mobile, but having a very slow movement, and differing from the preceding one especially by being gram-positive.

The bacillus developed at 70° was used for the inoculation of a sterilized 10 per cent. of the massecuite that had frothed. It was maintained at 70° C., when it developed readily.

INVESTIGATION OF THE PRODUCTS OF FERMENTATION OF THE AFTER-PRODUCT FROM THE MASSECUITES WHICH HAD BEEN IN "FROTHY FERMENTATION."

This after-product was obtained by filtration under reduced pressure (at the same temperature as that of the mixer), using the special apparatus in use in sugar factory laboratories for obtaining daily the coefficient of supersaturation of the molasses from second jet massecuites before machining.

In the case of "frothy" massecuites this filtration is very difficult, and, owing to its ropiness and stickiness, some hours of suction were required to obtain quite a small quantity. This filtration is slower as the temperature is lower, for at 60° C. it was impossible to obtain any more of the after-product. What was obtained, was kept for two months before being analysed.

In this after-product, volatile organic acids, as well as lactic acid, formed during fermentation were identified. The volatile fatty acids were determined by the classical method of DUCLAUX, and the *modus operandi* of Mr. SAILLARD was followed[1], this having been verified by me and found very exact. The lactic acid was extracted by ether in a continuous FISCHER apparatus using the after-product acidified by sulphuric acid, then determined as zinc lactate, while still following Mr. Saillard's procedure.

In order to compare this after-product with sound molasses, these same acids were determined in a sample of the molasses coming from the same factory and in the same campaign, as well as in another sample of molasses originating from another factory. The results found were as follows:—

---

[1] *Essais faits au Laboratoire du Syndicat des Fabricants de Sucre de France, 1911-1912 : Acides de fermentation dans les melasses.* E. SAILLARD. Page 123.

Analysis of "frothy" after-products and molasses.

	After-product from the massecuite that had frothed.	Sound Molasses from the same factory.	Sound Molasses from another factory.
True Brix	88·50	77·15	81·74
Direct polarization	57·85	46·10	47·90
True purity (using the direct polarization)	65·36	59·75	58·60
Invert sugar	2·38	none	none
Total nitrogen, per cent. of the molasses	1·21	1·939	1·981
,, ,, ,, of the dry matter	1·31	2·510	2·420
,, volatile organic acidity, as acetic acid, per cent. of the molasses.	2·275	1·305	1·230
Volatile acidity, per cent. of the dry matter	2·570	1·691	1·504
Volatile acidity, per cent. of the nitrogen	188·90	67·30	62·70
Lactic acid, per cent. of molasses	0·35	0·52	0 44
Reaction to phenolphthalein	acid	alkaline	alkaline

Fractional distillation of the volatile acids by the Duclaux method.

Volume of Liquid distilled in c c	Acid distilling over per cent of total acidity of the liquid After-product from the massecuite that had frothed	Sound Molasses from the same factory.	Sound Molasses from another factory
10	6·58	6·66	5·64
20	13·17	13·30	11·76
30	20·35	20·00	18·24
40	27·54	27·10	25 32
50	34·73	34·70	32·48
60	44·31	43·30	40·91
70	50·30	50·90	48·10
80	61·77	60·00	56·04
90	70 65	68·00	65·52
100	83·83	78·40	75·42

Formic acid was present in the distillate, silver nitrate being reduced on heating, so that it would contain (as in Mr. Saillard's experiments) acetic acid mixed with a greater or less quantity of higher and lower fatty acids.

In order to obtain a normal fermentation with a massecuite that has frothed, it is necessary preliminarily to submit it to boiling in presence of sulphuric acid, which is not so with sound molasses.

Identification tests by different processes were also made to see whether the after-product contained matters of a gummy nature, not met with in the sound state; but no result interesting to this paper was obtained.

INVESTIGATION OF THE PRODUCTS FORMED IN THE YEAST EXTRACT CULTURES AT 68°–70° C.

During the development of the culture, there had been a rather strong evolution of carbonic acid gas. The identification of the fatty acids, as well as lactic acid, unfortunately was made only with old cultures which had remained for about 45 hours at the ordinary temperature. The fractional distillation of the volatile fatty acids of the cultures in yeast extract gave the following figures:—

Volume of Liquid distilled in c.c.	Acid distilling over per cent. of the total acidity of the liquid
10	7·6
20	14·6
30	22·3
40	30·7
50	37 7
60	45·4
70	50·3
80	61·5
90	73·4
100	82·8

RESULTS OBTAINED FROM THESE RESEARCHES.

(1) Massecuite in mixers is by no means sterile, and can contain micro-organisms. These may be in the state of rest, that is, as spores or as organisms not in development, but it is not impossible that certain of them under special conditions of medium may there be found in the active state.

(2) They may contain a thermophylic micro-organism or one that is more or less falcutative thermophylic (since it develops also at 40° C.), having its optimum temperature about 70° C. and disengaging carbon dioxide. This high temperature of growth is nothing special, bacteriological researches having shown the existence of micro-organisms developing at temperatures still higher.

(3) The thermophylic organism found in this study grows specially well in media containing invert sugar having a neutral or slightly acid reaction to phenophthalein. Alkalinity hinders its development at 70° C., and is less inhibitive at 40° C., which is not unusual, for it is known that when investigating the death temperature of a micro-organism, this point varies very much with the reaction of the medium. The fact that it develops very readily at 70° C. in the presence of invert sugar, and almost not at all at 70° C. in the presence of sucrose alone in neutral medium would lead one to suppose that the hydrolysing enzyme of the micro-organism acts with difficulty at 70°, being, however, even more active in neutral and alkaline media, since the micro-organism develops even in alkaline solution in the presence of sucrose alone.

(4) The question arises whether the micro-organism exists in normal alkaline massecuites that do not exhibit this phenomena of "frothy fermentation." Unfortunately, none such massecuite was inoculated, but shortly it is hoped to examine the point.

(5) If one examines the fatty acids produced by fermentation contained in the after-product that had frothed, and compares them with those of sound molasses, it will be seen that the quantity is much greater per cent. of dry matter in the after-product that had frothed. Moreover, it will be remarked that the after-product that had frothed contains 2·8 times more acid per cent. of nitrogen than the other. This is due, at least in part, to the fact that these massecuites are not natural products of the sugar factory in the sense that in boiling the first jet much refinery after-product is returned, but it would not be impossible that during the phenomenon of "frothy fermentation" there may be an attack on the nitrogenous matter.

GENERAL CONCLUSIONS.

This study evidently does not prove that the cause of the "frothy fermentation" of massecuites is certainly of bacteriological origin; but neither does it prove that the micro-biological theory is completely impossible; far from it, for it is seen that many conditions favourable to the development of isolated thermophylic bacteria are precisely the conditions necessary to the production of this phenomenon.

It is also certain that if one admits as possible a micro-biological cause, there exists against this theory yet many points that are obscure and even contradictory; but it may be remarked particularly that the fact that certain phenomena of the kind originate from the development of a micro-organism does not imply that all the cases observed of what is generally called "frothy fermentation" should always have the same cause.

Thus CLAASSEN reproaches the micro-biological theory with the fact that the phenomenon may be observed at 90° C. The micro-organism found in this study evidently could not develop at this temperature, but the fermentation phenomena that were observed by me did not commence at 90° C. but towards 85° or 83° C., having their maximum intensity at 75° or 70° C., to finish at about 60° C.

Furthermore, this temperature at 85° C. is that given by the thermometer mixer, which was plunged into the lower part of the vessel, but it is to be doubted whether the higher layers in direct contact with the surrounding air really have this temperature of 85° C. Cooling is not so pronounced in the lower parts, the mixing of the massecuite being more or less perfect.

Another strong reproach against the micro-biological theory is the uncertainty that an organism is capable of developing in a concentrated supersaturated solution, such as a massecuite at this high temperature. This criticism is evidently well founded and very exact, but we may find the following fact also very curious: The phenomenon of "frothy fermentation" takes place at the high temperature of 75° to 70° C. It finishes towards 60°. Now at 75° C. the after-product is less viscous than at 60° C. Is there not a connexion between these factors? There is the possibility of the development of a thermophylic micro-organism in a less viscous medium. It is true that these are more or less presumptuous hypotheses, inasmuch as the scientific cause of the phenomenon of "frothy fermentation" has not really been demonstrated; for, admitting the chemical theory of LAFAR, there are some inexplicable cases. Thus the writer has had a case of "frothy fermentation" in a special massecuite, the after-product of which contained only traces of nitrogen, that is, in too small quantity to provoke the chemical reaction admitted by the theory of LAFAR.

It would be interesting to determine the volatile fatty acids per 100 of sugar in the massecuite at the commencement of the phenomenon, that is to say, about 80° C., and also at the end at about 60° C., as well as the initial acidity of the massecuite and the acidity at 60° C. In this way it would be possible to see the increase of acidity during the phenomenon. It may be that if it is really of a bacterial nature, it would be suppressed about 60° C., on account of a too high viscosity as well as a too great acidity of the medium, since though the organism may develop very well in the presence of a trace of acidity, an excess of acidity will be fatal. It is hoped to continue this study, that is, if the writer should have the occasion to encounter another "frothy fermentation."

The *Board of Trade Journal* reports that "in the territory known as German East Africa" there should be a market for plant, of not too elaborate a type, for dealing with sugar cane in all the processes of manufacture into sugar.

Recent cables from Queensland confirm the news that the sugar production of that country this year is 300,000 tons; as the requirements of the Commonwealth are put at 275,000 tons, there is a surplus of some 35,000 tons which will be held in reserve.

The Employment of Electric Power in Sugar Factories.

By H. W. VAN DER LEE.[1]

(Specially translated by Ed. Koppeschaar.)

(Continued from page 222.)

THE CHOICE OF CURRENT FOR THE SUGAR FACTORY.

When we review the various machines in a sugar factory, we shall find that by far the larger proportion of them run at a fairly constant speed ; elevators, washing boxes, and slicing machines (for beets), transporters and chain conveyors, screw conveyors, mixers, juice pumps, water pumps (for both cane and beet), may all be driven just as well by means of rotary (polyphase) current as by direct current. The advantages of the rotary system over direct current, i.e., simplicity of design, safe working, greater durability and lesser first cost of the motor, should determine our choice. Once resolved to electrify a factory one should unhesitatingly fix on polyphase current.

As for the electrical cranes for unloading beets or canes, there is no reason why we should not adopt polyphase current as well in their case. The load is fairly constant, especially when the crane is equipped with only one motor, and the various lifting, turning and lowering movements are accomplished by means of friction clutches.

As regards centrifugals, we must note that the direct current motors possess the advantage over the other type as far as consumption of current is concerned. By using direct current motors regulated by the method of weakening the field and regaining energy by means of an electrical brake, the total energy needed may be reduced by about 50 per cent. as compared with what we would need, when a polyphase motor does the work. In the case of a suspended centrifugal, needing a period of 8 minutes to receive its load, the energy which is used per period may be taken as 350,200 kg. metres for a polyphase motor and 135,100 kg. metres (K.G.M.) for a direct current motor with speed regulation of 1 to 3 by weakening the field. This amounts to an average energy of 10·2 against 4 0 H.P. over the full length of the period.

The following range of choice will however suggest that we should not decide too quickly. For the driving of centrifugals all the following types are available : (1) Rotary current motors with short-circuit rotor ; (2) Rotary current motors with slip-ring rotor and starting resistance ; (3) Direct current motors with starting resistance ; (4) Direct current motors with starting and field regulation resistance. The first named, which is started by means of a single switch is simplicity in itself and takes first rank when it comes to selecting a motor to drive the centrifugals.

The short-circuit motor starts with a strong current and has a small starting torque. Consequently it will take a considerable time before the centrifugal reaches full speed ; for this reason this type of motor is usually connected with the centrifugal by means of a friction device. Hence when started the motor will run at first light, and will reach full speed quickly, while the centrifugal picks up little by little through the slip connexion. But for this frictional connexion, as to which opinions differ amongst engineers, the short-circuit rotor motor forms the simplest and also the cheapest solution. The rush of current which occurs when the motor is started is not so important as many people think, especially when the generator which supplies current to the battery of centrifugals usually also supplies current to other motors which are run uninterruptedly. In this case the rushes occasioned by the frequent starting of the centrifugal motors will account for only a small fraction of the total load, and will cause little trouble in the circuit. Besides, automatic voltage regulators can be fitted to avoid any variation in voltage.

---

[1] In *Tydschrift*, 1915-16, Nos. 11, 12, and 13.

The second method named, rotary motor with slip ring rotor and a starting resistance, and the third, direct current motors with starting resistance, may be regarded as of equal value, in respect to driving centrifugals. It is true, the motor runs only partially loaded when the centrifugal has reached full speed and in such a case the power factor, *cos.* ϕ, of the rotary current motor is small; but this will have little or no influence on the generators which supply the current, because that part of the installation which works continuously has a far better power factor and is the larger part. The influence of the power factor on the diameter and consequently on the cost of the wiring is small for the same reason, especially if we choose a voltage of 380 to 500 volts, thus lessening the cost of the wiring, compared with that for motors of lower voltage. In general the cost of the wiring will amount to an inappreciable sum if it is erected by firms who know how to handle the material in the most economical manner.

The direct current motor with speed regulator through a weakened field enables us to bring up the centrifugals to full speed almost without loss of energy. With these two systems just referred to, half the energy used for starting is converted into heat in this resistance and is consequently lost. When the centrifugal makes normally 900 revs. per minute and a direct current motor is used which works at 300 revs. with its strongest field, then the motor is brought up to this speed by means of a starting resistance, while the speed is raised from 300 to 900 revs. per minute by weakening the field, which is accomplished practically without any loss in energy. As with the centrifugal, the starting period needs the most energy; it will be clear therefore that a considerable saving of energy is obtained with the direct current regulating motor. This is still enlarged because the magnetic field of the motor is made stronger when the centrifugal is stopped; the latter thereby brakes itself and returns energy to the direct current circuit.

The saving however obtained by the continuous current motor has little influence on the total working costs, while on the other hand the cost of installation is appreciably greater. The expense for coal per H.P. hour in a sugar factory, where all the exhaust steam is utilized for heating purposes, does not exceed 0·05 of a penny. If we assume the power employed by a suspended centrifugal with 8 minutes period for filling to be 10·2 H.P. for a polyphase motor and 4 H.P. for a direct current one, then the latter gives a saving of 6·2 H.P. which in a campaign of 100 × 24 hours would amount to 100 × 24 × 6·2 = about 15,000 H.P. hours in fuel, or say an extra cost of a little over £3.

In order to raise the speed of a direct current motor (working at 300 revs. per minute when the field is strongest) from 300 to 900 revs., the field must be weakened till it is about one third of its maximum strength. The motor torque will however get weaker through the weakening of the field and yet must be strong enough when in the neighbourhood of full speed to speed up the drum with its load. The direct current motor therefore must be of greater capacity than a normal motor which retains its entire strength of field at its maximum speed. Obviously it requires the motor to be three times the normal capacity.

The energy consumed by the direct current regulating motor compared with that of the polyphase motor stands as 4 to 10·2, but the energy which the motor returns to the circuit when electrically braked must be added to the figure of real consumption of energy. This changes the ratio to one of 350,200 K.G.M. against 252,900 K.G.M., or an average of 10·2 to 7·4 H.P. The capacity of the direct current regulating motor may thus be taken as lower in this relation than that of the polyphase motor. The former motor of 7·4 H.P. is however just as large as a normal direct current motor of 22 H.P. and will cost therefore about 50 per cent. more than the polyphase motor of 10 H.P. with slip ring rotor.

Thus by driving the centrifugals by continuous current motors we may save in working costs. The cost of installation is however considerably higher. But there is more to be considered. When direct current is chosen for the whole factory in order to adopt the most economical method of driving the centrifugals, then the saving in working costs will be greatly counterbalanced by the higher rent and annual depreciation of the capital sunk in the machine, which is much more than for a polyphase installation. But if we adopt polyphase current for the entire factory and require direct current only for the centrifugals, then a transformer will be needed, thus making the saving an illusion and rendering the whole scheme more complicated. When current has to be purchased from a power station, the question is different again ; the price paid for it in such a case must be considered and compared with the saving in installation costs on the side of polyphase current.

In regard to the cost of wiring we must note the following points. For motors a voltage of 500 may be chosen. Unless special dynamos are installed for lighting purposes, we must not exceed a voltage of 440 for direct current ; by the aid of a three-wire system, the centre one of which is earthed, the motors are connected with the outer wires and the lamps connected to 220 volts.

With polyphase current we can apply a four-wire system with voltages of 380 and 220, or we can select a voltage of 500 for the power installations and 110 volts for the lighting since this strength of current offers less danger through accidental contact with the wires. The generators in this case will deliver the electrical energy at 500 volts, while we use a transformer for the lighting circuit, its primary voltage being 500 and the secondary 110. This arrangement is simpler than that of the direct current three-wire system which needs special dynamos.

THE ADVANTAGES OF ELECTRICAL MOTIVE POWER.

The question as to whether electrical power is to be preferred or not for sugar factories is in reality one of considerable importance especially in view of the fact, noted at the beginning of the paper, that in Cuba where so many centrals are being enlarged or improved and new ones built, the question of "electrifying" them is gaining numerous adherents.

Through electrical power, the production of energy can be centralized ; a few large machines working economically can be advantageously placed, and the steam they consume can be produced from a central battery of boilers equipped with all modern contrivances, aiming at a low coal consumption ; there will likewise be economy in lubricating and cleaning material, in supervision, and in handling. Electric motors do not need any special supervision, as is the case with isolated steam engines. For existing factories the question of space plays a rôle as well, for motors take up little room, less, in fact, than correspondingly powerful steam engines. On the other hand, we need extra space for a central power plant.

When factory owners come to settle this primary question the three following points must be studied :—

(1) Which system gives the lowest initial cost of installation ?
(2) Which system offers the lowest running costs ?
(3) How do we obtain the greatest working security ?

Without electrical power we must erect steam engines in various parts of the factory. Through steam engines a few transmission shafts are driven, and from these shafts the various machines are set working by means of belts. Moreover, the various pumps for boiler feed, wash-water, juice, air, CO_2, condensation water, and the like are usually built as steam pumps. The placing of these various machines depends greatly on the direction and situation of the transmission shafts and of the steam piping.

In the other case, i.e., with electrical power, a few large engines are erected in the central, each provided with, and preferably directly connected to, its own dynamo. The total power fixed upon should be such that the whole power consumption of the factory is covered by it.

Copper cables conduct the electrical energy to a main switchboard, erected in the central, from which board thinner cables radiate through the factory to take the energy where it is needed. When placing the machines, one need not trouble whether suitable transmissions are near by or not, as large transmissions and at the same time their heavy supports and roofing constructions can be omitted, and we need not take into account any transmissions and steam piping when choosing a site for the machinery ; we must therefore certainly count these as *advantages* of electrical driving.

One of the remarkable properties of the electric motor is, that it gives its work in the form which is most sought after, i.e., *rotating*. The electric motor therefore needs, with its greater speed, smaller dimensions and smaller weight and much lighter foundations, which will cost correspondingly less.

The transference of energy by means of steam pipes occasions loss through radiation, and, moreover, is rather costly to instal and to keep in order. With electrical transmission of energy, on the other hand, we use insulated copper wiring, having no losses worth mentioning ; the cost of installation is low, and the upkeep is trifling. As to running costs, we save lubricating oil and cleaning material and supervision, when we introduce electrical driving power. As regards coal, it is quite true that the exhaust steam of the many scattered steam machines and pumps is not lost ; the largest part of such heat is available for heating purposes The large steam engines of the electrified central, however, use very little steam, and consequently less heat in proportion to the power which they generate.

As to the actual cost of a H.P. hour, if a power installation is combined with a boiler installation for heating purposes, we calculate as follows :—

A factory needs 700 H.P., and also, for heating purposes, a quantity of 8500 kg. of steam is needed per hour, which steam has a pressure of 1·6 atmospheres (absolute). If this steam be produced in boilers of low pressure at, say, 2 atmospheres, and the useful efficiency is 75 per cent., then at 6000 calories heat per kg. of coal, we shall need per hour—

$$\frac{8500 \times 628}{6000 \times 0{\cdot}75} = 1180 \text{ kg. of coal.}$$

The steam engine with 1·6 atmospheres back pressure will consume 8500 kg. of steam of 10 atmospheres' pressure, which steam is available for heating purposes, after having done service in the machine.

For the production of steam we need, with the same quality of coal and the same useful effect of the boilers:

$$\frac{8500 \times 690}{6000 \times 0{\cdot}75} = 1300 \text{ kg. of coal.}$$

The production of power for the 700 H.P. consequently does not ask for more than 150 kg. of coal per hour, i.e., one H.P. hour will cost $\frac{120}{700} = 0{\cdot}172$ kg. of coal, at 16s. 8d., equal to 0·0344, say about 0·05 penny per H.P. hour. It is for this reason that saving of electrical energy does not play a great rôle, and complicated contrivances which have been treated in previous pages should be left out of consideration in a sugar factory: the installation gets more costly, and less reliable to work. Reliability to work will be reached only by choosing the simplest machines.

When the steam cannot be utilized for heating purposes, as is the case with unloading cranes and with cane locomotives, the loss of steam is considerable, and electrical drive is not a question of doubt. Where the steam engine in the central has a coal consumption of 0·17 kg. of coal per H.P. hour, a crane will, without condensation, supposing the use of steam is the same as for the other machine in the central, consume $\frac{1300}{700} = 1{\cdot}86$ kg. of coal per H.P. hour.

The rotary pumps, for fluids as well as for air and carbonic acid gas, are to be preferred, because they are connected to the motor, not needing any belts or other indirect forms of transmission. The space which they occupy is far less than that of corresponding old-type machines with pistons. Thus a steam turbine occupies one-third of the space of a horizontal steam engine of the same capacity, while its weight will amount to 15 to 25 kg. per H.P. against 60 to 100 kg for a steam engine. The exhaust steam of a steam turbine is quite free of oil, which must be an advantage for the heating surface where it is utilized. As steam turbines and rotary pumps above 400 H.P. are cheaper than corresponding piston machines, are subject to less wear, and consequently last longer, the initial cost, rent, and depreciation will be smaller.

[The question whether the cane rollers should follow the same rule, i.e., whether it can be recommended to drive them electrically, is not included in this treatise. We would imagine, however, that this question has been answered by actual practice. The difficulties attached to driving such heavy machinery as a set of mill rolls have been overcome. No doubt the preliminary crushing prepares a far more even work for the rollers than was formerly the case when without crushers. The general advantages attached to electrical drive, as against steam drive, quite naturally apply just the same for rollers as for any other machine in a sugar factory.—*Translator.*]

An explosion recently occurred at the works of the Molassine Co., Ltd., East Greenwich. The sphagnum room was wrecked and set on fire, and the force of the explosion damaged the roof, another part of the building being damaged by heat, smoke, and water.

A recent Trade Supplement of the *Times* reports that the prosperity of the sugar industry in the British West Indies is leading to a considerable increase in the demand for fresh equipment; but small plants are still being asked for, and some of these are for running by petrol or paraffin power. There is a fair enquiry too for stills for the manufacture of rum and alcohol.

The Determination of Pentoses and of Glutose by Means of Fehling's Solution.

By H. PELLET.

Fehling's solution is less rapidly reduced by pentoses (arabinose and xylose) than by invert sugar or its constituents, dextose or levulose, which difference is not perceived when the reduction of the Fehling's solution is operated by raising the mixture to boiling point for two, three, or four minutes, according to the method followed. Even when heating is carried out in the boiling water-bath (which gives an interior temperature of from 92°-96° C., or more, depending upon the surface of the vessel, and whether or not it is covered), and when heating lasts 12 minutes, all the pentose reacts on the cupric-potassic liquor.

But when one follows the method of heating to 63°-65° C. during only 10 minutes, the result is otherwise. In fact, the author has shown that by heating to 63°- 65° C., and by maintaining this temperature of the interior of the liquid for 10 minutes, all the invert sugar reacts upon the Fehling's solution. This is the author's new procedure, which has given him every satisfaction for the determination of reducing sugars in the different products of the cane or beet sugar factory.

This heating at low temperature has numerous advantages. The principal one is that the sucrose accompanying the reducing sugars does not react upon the copper liquor, and that the foreign organic matters (contained, for example, in cane molasses) are likewise without effect in this respect, or at any rate, the amount is absolutely infinitesimal. Whereas, if one operates the reduction by heating to 85°, 90°, or 92° C. or in the boiling water-bath, and particularly if the temperature is carried to boiling point for a greater or less time, first the sucrose and later the organic matter react, and the more rapidly, the higher the temperature, and the longer the time.

Thus, it was found with cane sugar factory products, giving, for example, 12·50 per cent. of reducing sugars by the author's new method of heating to 63°- 65° C. for 10 minutes, that 13-14 or 15 per cent. were obtained by increasing the temperature and the time, and by raising the liquid to boiling point.

This difference is very well seen with the product resulting from molasses after fermentation. In fact, if a sufficient quantity of yeast (say 50 grms, per litre) be added to wort containing only 100 grms. of molasses, absolutely all the sucrose is transformed into alcohol, and this very rapidly. But in the case of cane molasses, *glutose* remains.

Now if the unfermentable reducing substances be determined by heating the mixture of the Fehling's solution and the solution under analysis to 63°- 65° C. for 80 minutes, one will find the content to be 2 per cent. of the molasses. If, however, one heats in the boiling water-bath during 10 to 20 minutes, 3, 3·5, or 4 per cent. will be found. Lastly, if one carries the temperature to boiling point, 5, 6 or 7 per cent. of unfermented reducing substances will be obtained.

This is to be accounted for by the foreign organic matters (the sucrose having been eliminated) readily reacting upon the Fehling's solution. Nevertheless, it may be remarked that the heating to 63°- 65° C. for 10 minutes is insufficient when one wishes to determine either the pentose in the presence of reducing sugars, or the glutose after the complete fermentation of the sucrose, and the author has established that it is necessary to maintain the temperature of 63°- 65° C. in the interior of the liquid for 30 minutes. This increase of the duration of heating to 30 minutes in place of 10 minutes has no sensible influence on the action of the foreign matters on the blue liquor, and it is only an increase of temperature that has this effect.

Consequently, when it is believed that a more or less impure liquid contains pentoses, one must maintain the heating at 63°- 65° C. for 30 minutes, in order to cause the complete reaction of the Fehling's solution, and similarly when it is thought that glutose is present, which is generally the case with cane molasses, and with all cane products, commencing with defecated juice. In fact, glutose is the result of the action of alkalis on levulose particularly, as has been pointed out by Messrs. ALBERTA VAN ECKENSTEIN and LOBRY DE BRYN. As cane juices always contain reducing sugars in very appreciable quantities, it is not astonishing to observe the presence of glutose in cane molasses, although the normal juice of the cane may contain none. In a future article, the author will describe his process for the determination of glutose in cane molasses.

In the meantime, it may be said in regard to pentoses that it is necessary to establish in pure solution the quantity of cuprous oxide (or of cupric oxide, or of metallic copper) yielded by a known weight, while working under well determined conditions, which according to the writer as pointed out above are to heat the mixture of the copper solution and the liquid under examination at 63°- 65° C. for 30 minutes, in order to effect the complete reaction of the pentose and the cupric salt.

By modifying the conditions of heating, one will also vary the proportion between the pentose and the copper precipitated. This is how it is that one finds appreciable differences in the weight of copper precipitated by the same amount of different reducing bodies depending upon the method, this being due to the conditions of heating being considerably varied.

As to glutose, it may be said that for its determination one may apply the same method of heating as for reducing sugars, and may calculate its amount by adopting the factor corresponding to invert sugar and multiplying the result by two.

It may therefore again be insisted that one should adopt the principle of heating with Fehling's solution to a low temperature, namely 63°- 65 C maintained for 10 minutes in the case of impure liquids which may contain neither pentoses nor glutose. But the duration should be extended to 30 minutes in the analysis of products supposed to contain either pentoses or glutose, and by adopting methods of heating at a higher temperature and for a longer time, or else by operating at boiling point maintained for 3 - 4 minutes, one risks having too high results, representing two or three times more reducing sugars than are there in reality, depending upon much the nature of the organic matter accompanying the reducing sugars. Regarding this point, it may be remarked that the organic matter of beet molasses behaves much less actively towards Fehling's solution than that contained in cane molasses.

Mr. JAMES F. ILLINGWORTH, Professor of Entomology at the College of Hawaii, has been engaged by the Government of Queensland to investigate the cane beetle trouble in that State, and to report upon the most effective means of its control.

- - - - -

Owing to the shortage of sugar, and of bottles and tins, efforts are being made to popularize the drying of fruit for its preservation, and a firm has placed on the market an apparatus, which is claimed to be simple and efficient in operation. Prices range from £5 to £18 10s , one of the latter price having 12 trays, each 3 ft. × 2 ft , and holding altogether 228 lbs.

Publications Received.[1]

***Green Manures and Manuring in the Tropics.** P. de Sornay; translated by F. W. Flattely. (John Bale, Sons & Danielsson, Ltd., 83-91, Great Titchfield St., London, W.) 1916. Price: 16s. net; postage, inland, 8d., abroad, 1s. 6d.

In 1910 Mr. de SORNAY, at that time Assistant Director of the Station Agronomique, Mauritius, wrote a pamphlet entitled "Étude sur les Légumineuses." Encouraged by the favourable reception accorded this publication,[2] he expanded it as "Les Plantes Tropicales Alimentaires et Industrielles de la Famille des Legumineuses," to a large, up-to-date, and well illustrated work of reference, which volume[3] was likewise much appreciated by those working in this branch of agriculture, and was awarded a gold medal by the Société Nationale d'Agriculture de France.

This French work has now been translated into English, and we do not doubt that it will again meet with a warm welcome as an opportune and valuable contribution to the important subject of the cultivation of the *leguminosæ* crops. It gives the tropical agriculturist the fullest information on how to choose members of the widespread family of legumes most suitable for their requirements and the climatic and soil conditions surrounding them, and to cultivate them either for their seed and oil or as green-manures, cover-crops, fodder for cattle, or any other of the many purposes for which they are suitable. The value of the oil-seeds first as suppliers of the oil for edible butter and other purposes, and secondly as supplying poonac or cake as cattle feed or as a fertilizer, is now recognized on all sides; in either case the by-product is of great value to the land-owner and cattle-raiser, and often enables them to prosper, whereas without their help they would drag along as best they can. As an organic manure, such nitrogenous seed-cakes have a direct beneficial action on the soil, whilst they increase its fertility and ameliorate the moisture conditions by increasing the humus content.

As cover-crops and green-manures many of the *leguminosæ* family have no equal, since they help to enrich the soil whilst conserving and equalizing its moisture content. The universally acknowledged value of this family, therefore, has caused agricultural experts the world over to be inundated with queries as to which variety to choose, how to plant the one selected, and how to proceed after planting. All these and many other queries are answered in this book, which will enable planting experts to answer the questions put to them, and better still, will enable the planter to solve his own difficulties. It will meet, we trust, with well deserved success.

***A B C Five-Figure Logarithms and Tables for Chemists.** C. J. Woodward, B.Sc., late Head of Chemical Department, Municipal Technical School, Birmingham. (E. & F. N. Spon, Ltd., 57, Haymarket, London.) Price: 2s. 6d.; foreign postage, 2d.

These logarithm tables are constructed specially for use in chemical and metallurgical laboratories. In calculating analytical or experimental results, ordinary arithmetic is too tedious (and is archaic in these days for such work); a calculating machine is too expensive; a slide rule does not record the successive steps in the computation, and may not be sufficiently accurate; but logarithms overcome these disadvantages once one has mastered the slight difficulty at first experienced in finding a required number. Mr. Woodward's tables are particularly easy to use, and by means of his so-called "A B C" system, mantissae and logs. are found more rapidly and certainly than by the arrangement of "proportional parts" generally adopted, as we can testify from actual practical experience of both methods.

---

[1] Books and other Publications marked with an asterisk (*) can be ordered if desired through NORMAN RODGER, 2, St Dunstan's Hill, London, E.C. 3, but in that event the order should be placed with him direct and not through a bookseller. Those not so indicated should preferably be ordered from the source of publication, especially pamphlets to which no price is attached, as these are in many instances gratis Postage as a rule is extra.

[2] *I.S.J.*, 1911, 509. [3] *I.S.J.*, 1914, 129.

In addition to the five-figure logarithms, there is a series of other tables, these being: (1) for the conversion of Beaumé and Twaddle degrees to specific gravity or interchangeably; (2) for the correction of gaseous volumes (of particular value in nitrometer determinations, giving directly the percentage of say KNO, from the volume of NO); (3) for thermometric conversions; and (4) for the change of weights and measures; as well as other tables, showing, for example, gas contents, electro-chemical equivalents, and the tension of aqueous vapour, international atomic weights, and lastly factors for use in gravimetric analysis (calculated to five places) and their corresponding logs. We can highly recommend Mr. Woodward's little book, and have pleasure in bringing it before the notice of sugar chemists and engineers as a most convenient and highly practical compilation.

***Light and Colour Theories and their Relation to Light and Colour Standardization.** Joseph W. Lovibond. Illustrated by 11 plates, coloured by hand. (E. & F. N. Spon, Ltd., 57, Haymarket, London, W.) Price: 6s. net; foreign postage, 6d.

Mr. LOVIBOND was formerly a brewer, and his work on colour had its origin in an observation that the finest flavour of beer is always associated with a colour technically known as "golden amber," the flavour deteriorating as the colour assumes a reddish hue. The first experiments were made with an apparatus in which glass pieces of different colours in the form of long rectangular wedges were used, while correspondingly tapered glass vessels were made to contain the beers. This system, however, proved to be useless for the purpose, not only because the rate of colour increase was never in proportion to the rate of thickness increase, but also because no two substances are equal in this respect, each having a rate specific to itself. Ultimately, the instrument of the form now well-known to chemists was evolved, in which by the combination of red, yellow, and blue glass slips any colour or depth of colour can be produced.

This tintometer is at the present day in general use in many industries for the colour standardization of their products, as those of sugar refining, brewing and malting, wine and spirit manufacture, milling, tanning, dyeing and printing, paint and varnish manufacture, steel manufacture, mineral and vegetable oil refining, and the purification of water. It is also in use in pathological investigations, for it has been found that from a colour analysis of the blood (especially in anæmia) useful inferences may be drawn.

It is the object of the present publication to make generally known the theory of the methods of colour analysis and synthesis which have proved of such great value in the industries mentioned. It is demonstrated that colour is a determinable property of matter, and it is also shown that the methods recommended are thoroughly scientific in theory and practice, and that the results are not likely to be changed by further discoveries. Furthermore, out of the work done a new law has been developed, which is termed "the law of specific colour development," meaning that every substance has its own rate of colour development for regularly increasing thicknesses. We think that chemists who have worked with the tintometer will be keenly interested in Mr. Lovibond's book, which will enable them more thoroughly to realize the principles upon which his instrument is constructed.

The United States beet crop may come into its own in a striking manner this year, inasmuch as owing to the probable shortage of ships, the supplies from overseas may have to be limited to a considerable extent.

Efforts are being made under Government auspices to extend the beet sugar industry of Canada, and the establishment of a large beet sugar factory in the Red River Valley, Manitoba, is under consideration. There is a large dairy industry in that province of the Dominion, and the introduction in its midst of beet cultivation would tend to develop further the dairy business.

Brevities.

The British Empire League are actively canvassing for support amongst British traders of all classes towards the proposal to register a Mark of Origin to distinguish goods made or produced within the British Empire. France has already such a mark, Italy is about to adopt one likewise, and if the British Board of Trade are satisfied that the establishment of such a mark for the British Empire is substantially supported throughout the country they are certain to consider favourably any formal application made to them for any such registration.

The increased shortage of sugar in this country the last two months led the Food Controller during May to further curtail the amount of sugar allotted to the sugar users generally. They had already in March been cut down to the proportion of 40 per cent. of what they used in 1915, but this percentage is now reduced to 25 per cent. Meanwhile the supply of sugar recently available for the public has been no more than roughly half a pound per head per week.

A serious effort is now being made by the Food Controller's Department to provide a supply of sugar for preserving the coming fruit crop amongst private orchards in this country. Applications totalling about half a million have been lodged in response to a notice that would-be preservers of such fruit must apply to a given quarter for the sugar needed ; and whether the demand thus revealed can be satisfied or not, it will at all events give the authorities some definite idea of the extent to which the practice of private preservation of fruit holds sway in this country.

In discussing the future prospects of the German alcohol industry at a recent meeting of the Association of Spirit Manufacturers, HANS EDLER, of Putlitz, expressed the opinion that the outlook was very unfavourable. He said it was more than doubtful whether the Germans would be able for several years to dispense with potatoes for national nourishment to the same extent as formerly. In any case the consumption of brandy would be restricted, and new taxes would not leave alcohol untouched. High prices were to be expected, together with a decline in sales, owing to depopulation. If substitutes for potatoes were not provided by the distilling experts, the industry would pass through serious times.

The American Cane Growers' Association of Louisiana have offered the U S. Government the use of the sugar factories of its members for use in such manner as may be found advisable in meeting the demands which may arise in connexion with national defence. Approximately half the boiler capacity of Louisiana is installed in sugar factories.

According to official statistics, supplied through the *Board of Trade Journal,* the quantity of sugar cane crushed in Argentina during 1916 was 1,433,145 metric tons, while the quantity of sugar manufactured therefrom amounted to 84,069 metric tons, as compared with 149,299 tons in 1915 and 335,956 tons in 1914.

The spell of bad luck which has dogged Tucumán planters for some years in the way of droughts appears to be at an end, as it has rained abundantly of late both in the mountain districts and on the plains, and reservoirs are filling up. As a consequence, there will be plenty of water for irrigation when the next dry season sets in.

Losses by submarine depredations so overshadow all others, that it is apt to be overlooked that other marine risks add their quota to the shortage of sugar in this country. An American exchange records for example the stranding of a steamer laden with some 6,000 tons of sugar bound for the United Kingdom.

Correspondence.

JUICE FILTRATION.

To the Editor, "The International Sugar Journal."

Sir,—In your March issue there was an article[1] dealing with the problem of filtering all the mixed juice from the mill. It might be of interest to your readers to learn that we, at our factory, "La Grange," on the West Indian island of St. Croix—which lately passed from Danish to American rule—for the last two crops have been filtering all our juice through ordinary filter-presses, without the use of any other chemical than lime.

"La Grange" uses a 9-roller mill with crusher, grinding 330 tons of cane in 24 hours, with about 91 per cent. extraction, and giving approximately 110 per cent. of juice, equal to 360 tons of mixed juice in 24 hours. The latter is treated with milk-of-lime to neutrality and pumped through a heater, giving the juice a temperature of 108° C., and right through the filter-presses, where the working pressure is 40 lbs. per sq. in. The clarified juice is, of course, perfectly brilliant, and the filter-cakes are hard and dry. We use two big and three small presses, with, in all, 2165 sq. ft. (or 213 sq. metres) of filtering surface.

The analyses have on the average, for the last eight weeks, run as follows:—

	Brix.	Polarization.	Purity.
Mixed juice.. ..	12·8	10·65	83·5
Clarified juice....	13·0	11·2	86·1
Sweet liquor ..	—	—	88·3

Previously, we used the closed Deming apparatus, but now our entire clarification system consists of: Liming tanks, a pump, a heater, and the filter-presses.

Yours truly,
C. Y. G. Sörensen,
General Manager.

St. Croix, 4th May, 1917.

Review of Current Technical Literature.[2]

Experiments made on Java Plantations relative to the Loss of Nitrogen after Manuring with Sulphate of Ammonia or Nitrates of Soda or Potash. *C. H. van Harreveld-Lako. Archief, 1916, 24, Part 6, 177-204; Part 7, 207-216.*

In Java at least 50,000 tons of sulphate of ammonia, costing about £635,000, for a cultivated area of 246,954 acres, are used per annum, so that the question of the extent of the absorption of the nitrogenous fertilizer becomes one of some importance.

A means was devised for establishing a standard value known as the "coefficient of absorption of nitrogen" for the examination of different soils in this respect. For this purpose 50 grms. of the dry soil were mixed with 50 c.c. of water, and afterwards with 50 c.c. of a N/5 solution of ammonium sulphate, the whole being shaken up for two days, filtered, and the amount of ammonia determined in 20 c.c. of the filtrate by distillation. By multiplying the number of c.c. of N/10 obtained on distillation by 14, the coefficient of absorption of nitrogen is obtained.

For the majority of soils with a coefficient exceeding 140, no loss need be feared. Some with a coefficient below 80 might sustain a loss under particularly unfavourable conditions, such as torrential rains or floods. In general, soils of a coarse texture have a low coefficient, and show a fairly considerable loss of nitrogen. On applying a heavy dressing of manure, the loss of nitrogen increases.

Experiments were also made with nitrates of soda and potash, which have been in use in Java on cane plantations during the war. None of the soils examined had any high coefficient toward this fertilizer, and leaching experiments carried out during three days showed that a considerable quantity of nitrogen from the nitrate had been washed out. It is therefore concluded from the investigation that the use of nitrate of soda in tropical countries during or before the rainy season is of no advantage, nor is the employment of nitrate of potash on permeable highly irrigated soils to be recommended. In Europe the action of nitrates is more rapid and effective than that of sulphate of ammonia; but in the tropics, where the nitrification is so rapid, this difference in behaviour is unimportant.

---

[1] 1917, 125-130.

[2] This Review is copyright, and no part of it may be reproduced without permission.—(Editor, *I.S.J.*)

Utilization of the Fertilizer Constituents Contained in Cane Molasses.

W. E. Cross and W. G. Harris. Revista Industrial y Agricola de Tucumán, 1916, 7, No. 3, 95–103.

A study of the following table, giving figures representing the respective fertilizer ingredients found in Tucumán molasses, will reveal the richness of the product with regard to potash, nitrogen, and phosphoric acid, and in a former article[1] one of the authors has called attention to the importance of these constituents, while also making observations on the possibility of their utilization. This matter is now again taken up, and the results of a study of the ash of cane molasses and distillery vinasse are discussed:—

Sample.	Nitrogen	Ash	Phosphoric Acid (P_2O_5) per cent Molasses.	Phosphoric Acid (P_2O_5) per cent Ash	Lime (CaO) per cent. Molasses	Lime (CaO) per cent. Ash	Potash (K_2O) per cent Molasses.	Potash (K_2O) per cent Ash
A	0·54	7·44	0·13	1·7	0·71	9·5	3·34	44·9
B	0·59	6·82	0·17	2·5	0·46	6·7	2·96	43·4
C	0·76	10·89	0·14	1·3	0·72	6·6	5·18	47·6
D	0·85	9·68	0·10	1·0	0·82	8·5	3·87	40·0
E	0·60	8·85	0·14	1·6	0·97	11·0	4·11	46·4
F	0·55	6·94	0·15	2·1	0·38	5·5	3·26	47·0
G	0·74	9·54	0·13	1·4	0·95	10·0	4·05	42·5
H	0·70	10·06	0·15	1·5	0·64	6·4	4·93	49·0
I	0·66	7·54	0·21	2·8	0·41	5·4	3·92	52·0
J	0·76	7·45	0·16	2·2	0·71	9·5	3·62	48·6
Average	0·68	8·52	0·15	1·8	0·68	7·9	3·92	46·1

It is pointed out that these figures indicate what might be the approximate composition of the ash of molasses burned in specially constructed furnaces; but the composition of the ash of molasses incinerated in conjunction with bagasse would be very different, owing, not only to the mixture of the two residues, that of bagasse being rich in silica, but also to the possibility of the union of the alkali and lime of the molasses with this silica. The utilization of an ash of this class, and that of the ordinary molasses ash, would by no means be the same, though this silicate slag could not be considered at the present time as a product without value.

On studying the analyses of the molasses ashes, one sees immediately that the percentage of potash is high, namely, 45–50 per cent. as K_2O, corresponding to 66–73 per cent. of potassium carbonate, in which form, in fact, the potash is probably present. Therefore, the ash without requiring further treatment could be used or sold as a fertilizer, or sold as crude potassium carbonate for use in the manufacture of glass or soft soap, in dye work, or in washing wool. By lixiviating the crude ash several times with water, evaporating the solution, and heating the residue, there will be obtained a product which is considerably purer, and which therefore might result in greater utility.

---

[1] *Revista.* 1915, 6, No. 4

But the salt obtained by this simple method is a mixture of several constituents, and is a crude product. It is not difficult to separate many of these impurities by means of fractional crystallization, and on doing this three salts were obtained, these being whitish, and consisting of impure potassium sulphate, potassium chloride, and potassium carbonate, as the following table shows:—

	Fraction I.	II.	III.
Soda, Na_2O	2·8	1·6	1·9
Potash, K_2O	47·6	47·6	37·9*
Sulphuric Acid, SO_3	44·4	2·4	—
Chloride, Cl	—	34·0	1·0
Water, H_2O	1·6	14·5	32·6

This leads the authors to believe that it would be easy to prepare such products in the sugar factory. There are many industries in which they would be useful, and potassium sulphate, for example, might be employed in the manufacture of alum and glass, and potassium chloride after conversion to the nitrate for the manufacture of explosives. The simplest method, however, would be to sell the ash without any previous treatment as a fertilizer, or for any of the purposes common to crude potash salts. Especially at the present time, this commodity should sell easily at good prices.

Even more important than the molasses ash is that of the vinasse, the residue of distilleries. The utilization of this product would be advantageous in two directions, for not only would it increase the profits of the factory, but it would make unnecessary the throwing of the waste product into the nearest stream or river—an objectionable proceeding.

The most logical method of using the vinasse would be to evaporate it to dryness, say in a small effect to be used exclusively for the purpose, and sell the product without any additional preparation. Noel Deerr[1] has stated that it is almost impossible to concentrate vinasse beyond the state of a pasty substance, owing to its hygroscopic properties; but the authors have observed that by acidifying the partially concentrated vinasse with sulphuric acid, a complete concentration can be reached, and a black, dry, non-hygroscopic powder suitable for transportation in bags or barrels be obtained, its composition being as follows:—

	Per cent
Phosphoric acid, P_2O_5	0·75
Potash, K_2O	37 50
Nitrogen	—

There must exist a good market for this product, either as a concentrated potash fertilizer (containing about 60 per cent. of potassium sulphate), or as potassium sulphate in crude form, to be used as such, or converted into the pure salt. The simplicity of its preparation must not be lost sight of.

Fractional crystallization, employing the same method used in the case of the molasses ash, was also tried in the case of a solution made from the dry vinasse, after acidifying with sulphuric acid, the analyses of the three salts resulting being as follows:—

	Fraction I Per cent	II Per cent.	III Per cent.
Lime, CaO	16·1	1·1	—
Magnesia, MgO	0·7	1·0	0·6
Soda, Na_2O	2·6	2·1	4·4
Potash, K_2O	26·3	49·4	42·0
Sulphuric acid, SO_3	46·7	45·6	44·7
Water, H_2O	0·1	0·04	1 0

Of the three fractions, the first is the most impure, as it contains a considerable quantity of calcium sulphate, but by means of repeated recrystallization these salts would be raised in purity according to the demands of the market, though it would be difficult to effect such operations in a sugar factory economically.

---

* Equal to 55·7 per cent. of potassium carbonate, or 82·7 per cent. on the water-free basis.

[1] *Bulletin, 28, Hawaiian Sugar Planters' Association.*

In conclusion, the authors mention another method for the utilization of some of the fertilizing elements of vinasse, namely, that of precipitating the nitrogenous matter with lime. In this process, as described by DEERR and PECK,[1] the lime is added to the vinasse in the proportion of 1 or 2 per cent., and the precipitate formed is separated by filter-presses, a fairly dry and hard mass with 1·9 per cent. of nitrogen and 58 per cent. of water being thus produced. In their experiments along this line, the lime was added to the vinasse in various proportions at different temperatures, being in some tests boiled, and in others left to precipitate without being heated at all.

No of Test.	Nitrogen per cent vinasse.	Lime (CaO)	Treatment	Weight of precipitate, per cent	Nitrogen in dry precipitate, per cent	Nitrogen precipitated per cent vinasse.
1	0·148	2·5	Boiled 10 mins.	2·86	0·574	11·1
2	0·148	6·0	Cold	3·0	0·56	11·3
3	0·148	5·0	Boiled	3·3	0·595	13·2
4	0·148	1·5	,,	1·84	0·84	10·7
5	0·30	1·8	Cold	2·4	1·1	8·8
6	0·30	1·8	,,	3·8	1·5	19·0

It will be seen from the tabulated results that the lime served only to extract a small proportion of the nitrogenous substance of the vinasse, so it is concluded that it is not worth while to adopt this method on a large scale with Tucumán molasses. At first it was thought that the low yield of nitrogen was caused by the decomposition of the albuminoid substances during fermentation with the corresponding production of amides, which could not be precipitated. However, later it was found by analysis that only 22 per cent. of the total nitrogen was in the form of amides, thus disproving the theory.

RECENT DEVELOPMENTS IN SUGAR MANUFACTURE IN HAWAII. *R. R. Hind and E. Kopke. Proceedings of the Hawaiian Sugar Planters' Association, 1916.*

Transport of cane.—Track scales outside the factory should be provided with registering beams in order to avoid incorrect weights. For handling the cane, the Wick unloader is daily coming into more general use, but it would be desirable to have some mechanical arrangement for moving the mechanism from side to side, which cannot well be done by small-statured Asiatic labour. It has been found advisable in cane carriers to use iron slats, about ⅛ in. thick by 7¼ or 8 in. wide, instead of wooden slats, which generally are less serviceable.

Juice extraction and milling.—The introduction of Meinecke revolving knives has met with success, and about 12½ H.P. per lineal ft. of cane carrier is required for driving them, but they require considerable attention. Moore carrier clutches are being more and more adopted. Recent experience with the Searby shredder has demonstrated that the best position for it is between the cane carrier and the following crushing machinery, so that the cane from the carrier is cut by the revolving knives, and passes first through the shredder and then through the crusher, or, if there is not one, directly to the mill rollers.

Owing to the introduction of juice grooves the inclined type of housing is no longer considered necessary, as the pressure exerted against the top roller by the feed and back rollers can very nearly be equalized. Steel housings are taking the place of those of cast-iron, because it is found that a simpler method of attaching the king-bolt is possible by the use of steel, and the liability of housing breakage is then far smaller. Placing the jacks on top of the housing is now considered good practice. The old style intermediate carrier is giving place to newer designs, such as the Ewart or Ramsay, which give less cause for breakages and mean cleaner mills.

---

[1] *Bulletin, 28, Hawaiian Sugar Planters' Association*

Boilers, furnaces, and pumps.—Higher steam pressures than can be furnished by the older type of return tubular fire-tube boiler are now in demand, owing to the introduction of the steam turbine for working the Searby shredder and auxiliaries throughout the factory. The Stirling type seems to be favoured at present. In the 7 ft. × 20 ft. return tubular boiler, it is considered that the limit is reached as to size, and the need for higher pressures which would require heavier plates in construction makes it impracticable to design for more than 150 lbs. Experiments have been carried out with the purpose of determining the proper spacing of the bars, and the best inclination of the grates for the most efficient burning of the bagasse coming from mills crushing it practically to powder. The Gianca-Keech furnace seems to be meeting with success. For feeding the boilers the steam turbine or motor-driven, multi-stage centrifugal pump is taking the place of the old direct-acting pumps, and in Cuba some installations of Alberger pumps have been made, on account of the advantages in economy of operation, up-keep, floor-space, absence of valves, and the like, offered by this type.

Clarification.—For the subsiding of the treated juice, the system of intermittent settling has more advocates than that of continuous settling, and the tendency seems to be towards larger settling tanks.

Evaporation boiling, curing, etc.—For the concentration of the juice, the adoption of apparatus working on the film principle does not appear to make headway, standard evaporators, well designed, giving very satisfactory efficiency. In boiling, the calandria pan is taking the place of the coil type. Open, unjacketed U-type crystallizers, provided with driving arrangements allowing each vessel to operate individually by means of a friction clutch, are preferred to any other. As to centrifugals, 40 in. machines are mostly adapted for sugar intended for shipment, and 30 in. diameters for lower products. Belt-drive is still advocated by the majority, but it is recognized that water-drive offers very important advantages in the absence of shafts, pulleys, belts, &c., though these require considerable attention and up-keep. In Cuba the 30 × 18 in. centrifugal has been found a very desirable size, allowing all the speed of the smaller diameter with the increased capacity of the larger one, owing to the greater height of the basket.

The use of automatic weighing, bag-sewing, and bag-marking machines in the sugar room is recommended. The grass-hopper type conveyor is replacing belt and slat conveyors. It is considered that the filter-press department is one leaving much to be desired, and in it probably the greatest improvements may be expected in the future.

EXPERIMENTS MADE WITH "BACTERIZED PEAT." *James W. Tocher. Aberdeen Free Press, February 23rd, 1917.*

Some experiments were carried out by Dr. TOCHER under the auspices of the Governors of the North of Scotland College of Agriculture last summer with the object of investigating the claims made by Prof. BOTTOMLEY in respect of his preparation.[1] Although the trials were fairly extensive and thorough, it was thought that they could be regarded only as of a preliminary character, and in no way conclusive.

---

[1] *I.S.J.*, 1914, 238, 536, 1915, 96, 117, 192, 516, 577; 1916, 140, 198, 222, 233, 357, 472

In the first place, the season of 1916 was exceptionally wet, with the result that the yields, both of turnips and potatoes, were well below the average for the selected soils under ordinary treatment. There was a distinct inhibition of growth generally, and consequently it could not be said what the effect might have been in a normal season. In the second place, the effects of a dressing of bacterized peat at the rate of one ton per acre was very uneven in character. The effects of two ton rates were compared with the effects of one ton rates, and it was found that in three out of six compartments the yields from two ton quantities were distinctly less than those from one ton quantities. In the other three cases the yields were practically the same.

The general results so far showed that a dressing of bacterized peat at the rate of one ton per acre was much inferior to a dressing of sulphate of ammonia at the rate of one cwt. per acre. Of course, bacterized peat cannot be regarded as a quick fertilizer in the same sense as sulphate of ammonia. It is just common peat submitted to fermentative action, sterilized and inoculated with nitrogen-fixing bacteria. In several of the experiments it was found that the yield from the common peat plots were just as good as the yield from the bacterized peat plots. The Committee would like therefore to compare the yield from common peat which has been ripened and sterilized, but not inoculated, against the effect of inoculated, that is "bacterized peat." It is possible that the fertility value of bacterized peat might be largely due to the substance formed during putrefaction and to the absence through sterilization of the organisms hostile to the nitrogen fixers. The value of common peat as an enricher of poor sandy soils has long been appreciated by practical men. It is more than 100 years now since LORD MEADOWBANK pointed out the advantage of a manure heap composed of alternate layers of farmyard manure and peat. Bacterized peat might or might not possess advantages over such a mixture, but bacterized peat was looked upon in some quarters as a new and important advance in agriculture.

The Committee wishing thoroughly to test its value, Dr. TOCHER accordingly moved the following motion, adopted at the meeting of the Bacterized Peat Committee: "That a committee be appointed to be associated with the staff in reporting to the Board of Agriculture for Scotland on the results obtained from the experiments already carried out, and in conducting further investigations in connexion with bacterized peat." This was agreed to.

JAPANESE CANE. *John M. Scott.* *University of Florida, Agricultural Experiment Station, Bulletin 129, 1916.*

When first introduced into Florida, Japanese cane was grown for the production of syrup, but in most sections of the State certain other canes have been found to be more satisfactory for this purpose. Its chief value at the present time is as a forage crop for the feeding of live stock, and it may be used as silage, winter pasture, or as dry forage. It is urged that farmers should cultivate Japanese cane, and directions are given for its planting, cultivation, and harvesting. Fertilizer experiments were also conducted, and it is concluded that apparently the only effect fertilizers have on this crop is to increase the yield of green forage per acre, since the percentage of sucrose in the juice was practically neither increased nor decreased, the average being about 10·5 per cent, and the Brix of the juice about 15·8 degrees. Regarding the effect of fertilizer on the yield of cane per acre, it was found that on the soil concerned potash was most beneficial, next nitrogen, while phosphate appeared to be of less importance than either of these. Ground limestone acted as a temporary stimulant, no results in this respect being obtained after the first application. The yield per acre decreased on all plots each year, and it is therefore recommended that the cane be planted every third or fourth year.

J. P. O

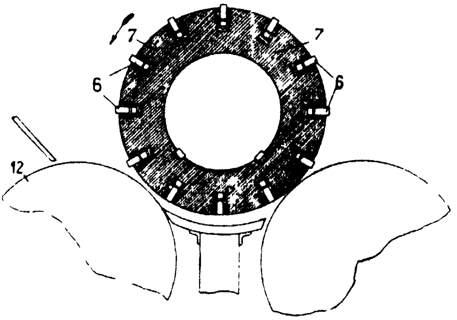
Review of Recent Patents.[1]

UNITED KINGDOM.

CANE MILL HAVING ROLLERS WITH RESILIENTLY MOUNTED PINS FOR THE INCREASE OF THE GRIPPING CAPACITY. *Abraham M. Erkelens*, of Soerabaja, Java. *12,265*. Applied for, August 25th, 1915.

In order to improve the gripping capacity of mill rollers, and thus favourably to influence the crushing of the cane, the circumference of the rolls is provided with pins or bars which extend beyond, and are arranged resiliently, so that they can be forced into the rolls until their outer ends lie in the cylindrical circumference.

As is shown in the figure, the pins 6 are placed in rows or arranged in any other formation in the outer circumference of the roll 7. The pins are provided with a collar 8, and are held in the holes 9 by means of threaded rings 10, screwed therein, till their outer ends are flush with the circumference of the roll. A spring 11 is arranged between the collar 8 and the bottom of the hole 9, keeping the pin extended when no force presses it inward.



When now the roll rotates in the direction of the arrow, the extending pins grasp the sugar cane and bring it between the roll 7 and the second roll 12. As soon as the cane is caught between the rolls 7 and 12, the pins 6 have done their work and are forced inward, thereby giving that portion of the roll the form of a plain cylinder.

According to another construction, in the longitudinal direction of the rolls are provided bars consisting of a front narrow part and a broader part or base. The bars are inserted in slots of such form that a space is normally left between the bars and the bottom of slots and are locked in position in the slots by means of the end flanges. In this space, springs are arranged which normally maintain the front parts projecting out from the circumference of the roll. The bars are provided with blocks which limit the inward movement of the bars. The latter have the same effect as the aforesaid pins but are in some cases more effective. The rolls according to the invention avoid a drawback of the known rolls provided with fixed teeth, whereby the cane is insufficiently crushed in the spaces around these teeth.

MANUFACTURE OF A FERTILIZER BY THE OXIDATION OF SEWAGE. *Gilbert J. Fowler and Gladys Mumford*, of 2, Danes Road, Rusholme, Manchester. *8397*. Applied for, June 7th, 1915.

In order to produce a fertilizer containing a relatively high percentage of nitrogen available for plant food, and also organisms in a state of activity serviceable to the production of a good crop, the inventors use the solid residue or sludge resulting from the oxidation of sewage matter through the agency of bacteria, by forcing air through the liquid in the presence of the bacteria, or from other sewage purifying processes, which residue has been heated and dried artificially, and either revivified or rendered active by the addition of a small quantity of a fresh active residue or sludge subsequent to drying, an effective bacterial fertilizer thus being produced.

---

[1] Copies of specifications of patents with their drawings can be obtained on application to the following:—*United Kingdom:* Comptroller of the Patent Office, Southampton Buildings, Chancery Lane, London, W.C. (price, 6d. each). *United States:* Commissioner of Patents, Washington, D.C. (price 5 cents each). *France:* L'Imprimerie Nationale, 87, rue Vieille du Temple, Paris (price, 1 fr. 05 c. each). The date given in the heading of United Kingdom specifications is that of the application of the patent.

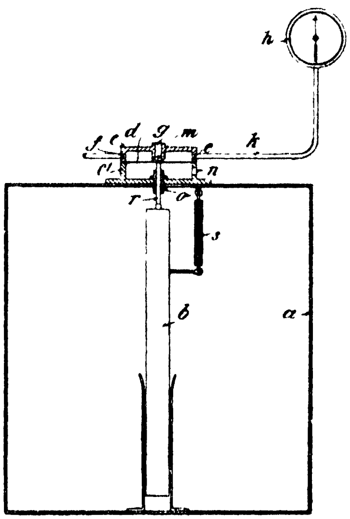
MANUFACTURE OF A FERTILIZER FROM CANE OR BEET MOLASSES OR VINASSE. *Wm. P. Thompson*, of 6, Lord Street, Liverpool. (Communicated by *Abram I. Kaplan*, of New York, U.S.A.). *9270.* Applied for, June 24th, 1915.

Distillery slop, or the waste product in the manufacture of alcohol from cane or beet molasses, of a gravity of 3-5° Bé. (5·3–8·9° Brix) is concentrated to 44° Bé. (81·8° Brix) in a triple effect apparatus, the heavy vinasse produced being mixed with 30- 35 per cent. of its weight of finely ground phosphate, guano, or bone meal, and the resulting mixture treated with sulphuric acid of 66° Bé. (sp. gr., 1·842 ; 168·4° Tw.) in sufficient quantity to produce superphosphate and convert the carbonates to sulphates. After thorough mixing the mass is allowed to cool, a dry fertilizer that can easily be spread, and contains soluble phosphates, potash, nitrogen, and organic matter, being thus produced

MEASUREMENT OF THE DEPTH OF LIQUID IN TANKS. *Frederic H. Clift*, of 95, Castlenau, Barnes, London, S.W. *103,390* (*4500* of *1916*). Applied for, March 27th, 1916.

It is the purpose of the invention to simplify the apparatus of the kind, avoiding the variations of pressure which arise, due to temperature or barometric pressure. This end is attained by utilizing the varying levels of the liquid in the tank or other vessel to control the leakage of air from a box or chamber, which is in communication with the pressure gauge, and into which air under pressure is admitted.

Referring to the figure, in the vessel *a* adapted to contain the liquid the quantity of which it is desired at any time to measure, is a buoyant body *b*—hereinafter for convenience called a float—which is guided in any suitable manner, so that it has a vertical or approximately vertical motion in said vessel. On the top of the vessel is mounted a pressure box which for convenience is formed in two parts, an upper part *c* and a lower part c^1. These two parts are divided by a flexible diaphragm *d* which is preferably of the corrugated type. In the upper part *c* of the box are three orifices or ports one of which *e* is in communication with a delicate pressure gauge *h* by means of a suitable pipe *k*, another of which *f* is in communication with a source of supply of air under slight pressure, and the other of which *g* is open to the atmosphere. This latter is shaped on its inner side to form a seating for a valve *m* carried by the flexible diaphragm *d*, the whole forming an escape valve. In the lower part c^1 of the pressure box, which is open to the atmosphere by a port *n*, is a centrally arranged guide bush *o* in which is mounted a spindle *r* the function of which is to impart the upward movement of the float *b* to the flexible diaphragm *d*. The air inlet port *f*, which may be located in any other suitable part of the circuit, for instance in the pipe *k*, is preferably provided with a choking hole, in order that the air for the apparatus may be taken from a source the pressure of which is not constant, such for instance as the pressure in the fuel tank when pressure feed is employed.



As no material which can be practically used for the float is sufficiently buoyant to operate without any submergence, it follows that there must be a certain depth of fluid at the bottom of the tank which cannot be measured. To reduce this to a minimum the float is relieved of this non-buoyant weight by balancing it by means of a spring or its equivalent. In the construction shown in the accompanying drawing the float is suspended on a long coiled spring *s* the strength of which is sufficient to keep the valve *m* up in contact with the seating at the inner end of the port *g*.

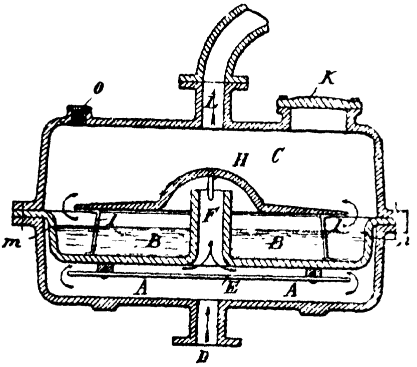
On air under pressure being admitted to the pressure box, the pressure therein operates to exert a downward pressure on the float *b* through the diaphragm *d* and the spindle *r*, such pressure depending upon the upward pressure of the float, which depends on the amount same is submerged, it being obvious that the upward pressure of the float will increase as the quantity of liquid in the vessel increases and *vice versa*. When the pressure in the pressure box exceeds the upward pressure of the float on the diaphragm the escape valve will open and thereby reduce the pressure in the pressure box and allow the float to again close the escape valve. By this means a balance is arrived at whereby a definite pressure is maintained in the pressure box which gives a reading on the gauge which is a measure of the depth or quantity of liquid in the vessel according as the gauge is calibrated.

It will be seen that in this apparatus any rise of pressure in the pipe leading to the gauge due to rise in temperature or to variation in barometric pressure is immediately corrected by the action of the escape valve under the control of the buoyant body in the liquid. Therefore, the gauge gives a correct reading under all conditions.

SULPHUR OVEN FOR THE PRODUCTION OF SULPHUR DIOXIDE INDUSTRIALLY FREE FROM OXYGEN FOR USE IN THE MANUFACTURE OF HYDROSULPHITES. *Louis Descamps*, 6, Place Gambetta, Chateauroux, Indre, France. *100,939 (1010 of 1916)* Applied for, January 21st, 1916. Accepted, August 10th, 1916. Under International Convention, July 18th, 1915 (France).

When burning sulphur in a sulphur oven in the ordinary way, that is, when complete combustion of the sulphur is effected, an excess of air must be used, and the sulphur gases produced contain a greater or less amount of oxygen. In order, however, to produce gases containing sulphur dioxide free from oxygen, such that may be used in the manufacture of a hydrosulphite, a different procedure must be adopted. According to the present specification, in order completely to utilize the oxygen admitted into the oven, the air is previously heated suitably, and this hot air is brought in a thin layer into contact with the burning and molten sulphur.

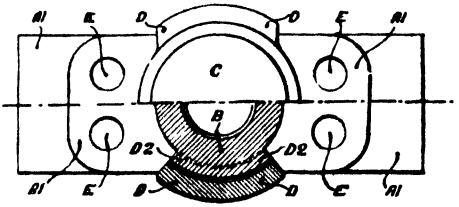
As is shown in the figure, the oven is circular, and comprises three essential parts: An air heating chamber *A*, a sulphur pan *B*, and a combustion chamber *C*. The sulphur is introduced into the chamber *C* through a charging door *K*, which is closed hermetically. An orifice closed by a screw stopper *O* affords a passage through which the sulphur may be ignited. The sulphur melts rapidly and collects as a liquid layer in pan *B*. The charge of sulphur introduced through *K* is such that the level of the liquid sulphur is never above the level *m n*.



Atmospheric air, as dry as possible, adjusted in quantity by any suitable known device, is admitted by the pipe *D*. It is heated by passing along the chamber *A* past the circular baffle plate *E*, and then flows through the vertical pipe *F*. As it leaves this pipe, the air is reflected on to the bath of liquid sulphur *B* by a circular cap *H* supported by feet *I*. The hot air in licking the large surface *m n* of the liquid sulphur is almost completely deprived of its oxygen which burns to form sulphur dioxide (SO_2). The mixture of sulphur dioxide and nitrogen leaving the opening *L* is conducted into any known purifying apparatus which condenses sulphur vapour, before being brought to the apparatus for using the mixture for the manufacture of hydrosulphite, or other purpose.

HYDRAULIC PRESSURE REGULATING GEAR FOR MILLS. *William Mackie*, of 11, Walmer Crescent, Paisley Road West, Govan, Glasgow, N.B. *101,160 (160 of 1916)*. Applied for, January 5th, 1916. Accepted, August 24th, 1916.

According to the present design the combined cylinder and plug, instead of being made so that it is inserted and secured within the outward extension on the cap, is made with a part (or parts) depending from the cylinder, so that it extends downwards outside of the outward extension on the cap. Between this extension of the cylinder and the extension on the cap, there are provided any of those now well known devices hitherto applied for retaining the plug or combined cylinder and plug within the cap. For example, the part depending from the cylinder has formed on it an inwardly extending interrupted flange to co-act with a counterpart interrupted outwardly projecting flange on the extension of the cap, or there may be two or more of such counterpart co-acting interrupted flanges in the length of the co-acting surfaces, or these counterpart co-acting surfaces may be in the form of interrupted screw threads. With this improved construction the overall diameter of the extension on the cap and the cylinder which that extension carries may be less than the space between the nuts securing the headstock bolts, so that these bolts may be withdrawn without disturbing any part of the hydraulic pressure-regulating gear. Any usual packing may be employed between the head of the ram and the cylinder in which that head works.



Thus, as is shown in the sketch, the combined cylinder and plug *C* is made with two segments *D* depending therefrom on opposite sides thereof so that they extend downwards outside of the outward extension or head *B* on the cap A^1. The depending segments *D* have each on their lower ends an inwardly extending flange, and two counterpart outwardly projecting flanges D^2 are formed on the head *B* at right angles to the longitudinal centre line of the cap A^1. The combined cylinder and plug *C* is secured in place on the head *B* by first placing it thereon with the depending segments *D* over the bolt holes *E* and giving it a quarter-turn to cause the counterpart flanges D^1 and D^2 to engage each other.

As with this improved construction the head need only be of an internal diameter to receive the ram, and not also increased in diameter at the part just beyond the nuts to receive within its upper end the combined cylinder and plug, as in certain hitherto known constructions, and as, when the combined cylinder and plug is secured in position, the cylinder is above the head and no parts project over the ends of the bolts, these bolts may be withdrawn without trouble or loss of time.

USE OF DECOLORIZING CARBON, WHILE PARTLY INVERTING SUGAR SYRUP. ***J. J. Eastick, J. C. N. Eastick, and A. G. Eastick,*** all of 2, St Dunstan's Hill, London, E. C. *104,231.* (*3425 of 1916*) Applied for, March 8th, 1916. Accepted, March 1st, 1916.

This invention comprises an improvement or modification of that described in Specification No. 5900 of 1914.[1] In the manufacture of jam, jelly and certain kinds of confectionery, it is no detriment to use a sugar or syrup containing a small quantity of invert sugar, in fact, in many cases it is an advantage, particularly when the natural acidity of the fruit is insufficient to invert the necessary amount of sucrose to ensure the proper keeping quality of the finished product.

The presence of acid in a raw sugar syrup will very considerably reduce the amount of carbon necessary to decolorize, though at the same time it will cause inversion. In Specification 5900 of 1914 the maximum amount of acid may be used, as the final product is required in the inverted state, but in this Specification the procedure has been modified, so that the amount of acid used will correspond to the moderate amount of inversion useful for the purpose in view.

In practice, the decolorizing carbon is added to the sugar solution at a very early stage with continued agitation, so that decolorization takes place simultaneously with inversion, a great saving of time thus being effected. A stream of air, or of oxygen, for agitation is rather to be preferred to merely mechanical means, since it aids in the removal of dark coloured products. As to the quantity of the carbon to be used, this will vary from 1 to 10 per cent. of the weight of sugar to be decolorized. It may be filtered from the solution and by suitable means prepared for re-use, while the filtered solution is neutralized, if necessary, again filtered, and subsequently treated in the usual way. The quantity of acid should be the maximum that can be used without causing inversion, namely 10 to 15 times that permissible in Specifications 21,204 of 1911 and 11,860 of 1912, and about half that required in 5900 of 1914. For good raws, 100 c.c. of a 50 per cent. solution should require about 100 c c. of a N/10 solution of alkali for neutralization

---

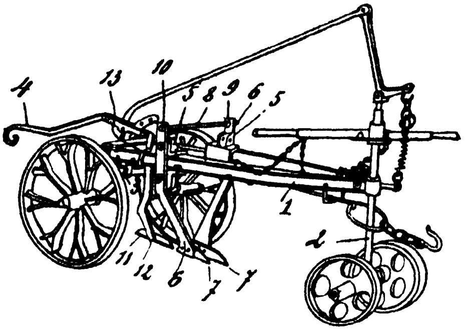
[1] *I.S.J.*, 1915, 242.

* * *

DIGGER FOR BEET OR OTHER ROOTS. *G. M. Clark*, of 53, Chancery Lane, London, W.C. (Communicated by *Landrain Bros.*, of Fexhe le Haut Clocher, Belgium). *13,741*. Applied for, September 27th, 1915. Accepted, September 27th, 1916.

A digger for beet or other roots planted in lines is described. It has specially formed shares or knives, which permit all the roots to be dug up, whatever may be their dimensions, at the same time diminishing the resistance to the traction of the machine.

As is illustrated in the figure, it is composed essentially of an angle iron frame *1* mounted on four wheels, and supported in front by an upright standard *2* and in rear by a bent axle *3*. The steering is effected by means of the front wheels while the rear part of the carriage can be raised and lowered by means of a rack and the lever *4*. On the sides of the frame *1* two flat bars *6* are fixed by means of cast-iron brackets *5*, said bars passing under the frame and each carrying a share or knife *7*. These shares *7*, inclined outwardly from the axis of the apparatus, form a channel which gets narrower and narrower and the width of which can be regulated by means of a threaded rod *8* which passes through the heads of the bars *6* It is sufficient to turn the nuts *9* and *10* arranged on the rod *8*, inside and outside the respective bars *6* in order to cause the shares to approach or separate The shares *7* are separated towards the rear by a flat blade *11* slightly inclined towards the ground and supported by an arm *12* fixed to the frame *1* by a collar *13*. The blade *11* is intended to direct towards the centre the roots which have been dug up, these sliding thereon, and is not employed when use is made of shares which have an upwardly-extending portion, which serves to guide to the rear the dug up beetroots so that they fall in a line on the ground.



Each of the shares is formed with its upper edge convex and its base concave, so that the junction of the downwardly-directed curves forms a very elongated and tapering point which is situated in the same horizontal plane as the rear part of the base thereof. Owing to this particular shape, the penetration of the shares into the ground is very much reduced and does not exceed 5 to 6 centimetres, so that the tractive effort is reduced, the friction of the shares on the ground being also very much diminished.

* * *

MARMALADE MANUFACTURE. *Robert J. Russell*, 275, High Rd., South Tottenham, London, N. *101,463* (*8951 of 1916*). Applied for, June 26th, 1916. Accepted, September 21st, 1916.

The peel or rind is converted to a pulpy state by any suitable means, as passing it between rollers, grinding, pressing, crushing, or other process by which the structure is broken up, more especially that of the coloured or outer skin, which is usually tough or hard in marmalade as now made. This pulping process releases from the cells of the peel, juices, oils and flavouring matters, which should be retained and can more evenly be mixed with the pulp, thereby improving the flavour.

The fine pulpy mass of the peel can be treated by adding a little gelatine, starch glucose, or farinaceous material well-known to confectioners, in quantity just sufficient to make a stiff dough, which may be coloured, if desired. This dough is pressed through perforated plates to form threads, or made into flakes, lozenges, stars, or other shapes, and may be sugared before being added to the other portion of the fruit

It is the object of this invention to produce a digestible form of marmalade in which the peel having been prepared as described is mixed with the other portion of the fruit in such a way that the flakes, threads, lozenges, stars, or other forms given to the pulp when mixed will be well distributed throughout the confection and visible, as in marmalade in which the peel is in the form of cuttings, slices, or threads

---

EVAPORATOR, THE FIRST UNIT OF WHICH IS FIRE-HEATED. *William Anderson,* of Inistore, Helensburgh, N.B. , and *James Meikle,* of 14, Garrioch Drive, Maryhill, Glasgow, N.B. *15,547.* Applied for, November 4th, 1915. Accepted, May 25th, 1916

The apparatus comprises a series of effect bodies, one of which (at least) is heated by gases from a furnace. This fire-heated unit consists of an upper and a lower liquid-containing drum connected by upright water tubes traversing the flue through which are led the hot gases from the furnace It serves as a generator for vapour which is led into the calandria of each of the succeeding units, in which evaporation is effected at sub-atmospheric pressure. The liquid to be evaporated first enters the first unit, and passes from it to the others continuously, the pressure decreasing in each unit. Thus, the first unit serves not only as a generator, but also constitutes the first stage of a multiple effect apparatus.

UNITED KINGDOM APPLICATIONS

MANUFACTURE OF ANHYDROUS HYDROSULPHITES *E. F and H. W. Ehrhardt. 266.* January 5th, 1917.

MANUFACTURE OF INVERT SUGAR *N. W. Taussig. 1293.* January 25th, 1917. Under International Convention, February 7th, 1916, United States.

CONCENTRATION APPARATUS FOR SUGAR REFINERIES. *L. N. J. Elias. 1619.* February 1st, 1917.

SWEETENING MATERIAL. *J. H. Wrigley. 1783.* February 5th, 1917.

FERTILIZER. *J. G. Lipman 1881.* February 7th, 1917. Under International Convention, United States, February 17th, 1916

EVAPORATOR. *A. Bontemps and G. N. Vis. 1903.* February 7th, 1917.

CENTRIFUGAL *L. Hall. 1996.* February 9th, 1917

CENTRIFUGAL. *E. R. Curtis. 2107.* February 12th, 1917.

CENTRIFUGAL. *W J. Gee. 2579.* February 21st, 1917

MANUFACTURE OF PHOSPHATIC MANURE. *S. Crook and F W. Gilbertson. 2819.* February 26th, 1917.

EVAPORATOR. *E. J. Fawke and H. Griffiths. 3030.* March 1st, 1917.

SUGAR EXTRACTED FROM PEAT IN COMBINATION WITH SACCHARINE SAPS AND STARCH FROM PLANTS. *W. Baines and W Hamilton. 3098.* March 2nd, 1917.

COOLING PLATES FOR CONTINUOUS RECTIFICATION APPARATUS. *Soc. E Barbet et Fils et Cie. 3444.* March 8th, 1917.

PREPARATION OF SUPERPHOSPHATES. *Chemische Fabrik Milch Akt.-Ges. and O. Rabenau. 3509.* March 9th, 1917.

COMPRESSING FILTER PULP CAKES OR DISCS FOR FILTER-PRESSES. *F. F. Briginshaw. 3554.* March 10th, 1917.

United States.

(Willett & Gray, &c.)

(Tons of 2,240 lbs.)	1917. Tons.	1916. Tons.
Total Receipts January 1st to May 17th	1,290,133	1,287,103
Receipts of Refined ,, ,,	—	—
Deliveries ,, ,,	1,245,099	1,265,935
Importers' Stocks, May 16th	55,999	25,246
Total Stocks, May 16th	355,443	168,362
Stocks in Cuba, May 16th	608,302	942,333
	1916.	1915.
Total Consumption for twelve months	3,658,607	3,801,531

Cuba.

STATEMENT OF EXPORTS AND STOCKS OF SUGAR, 1914-1915, 1915-1916, AND 1916-1917.

(Tons of 2,240 lbs.)	1914-15 Tons	1915-16. Tons	1916-17 Tons
Exports	1,107,060	1,419,281	1,279,111
Stocks	619,102	917,872	737,649
	1,726,162	2,337,153	2,016,760
Local Consumption	28,930	31,650	38,000
Receipts at Ports to April 30th, 1917	1,755,092	2,368,803	2,054,760

Havana, April 30th, 1917.

J. GUMA.—L MEJER.

United Kingdom.

EXPORTS OF SUGAR.

	MONTH ENDING APRIL 30TH.		THREE MONTHS ENDING APRIL 30TH.	
	1916 Tons	1917. Tons.	1916. Tons	1917 Tons.
BRITISH REFINED SUGARS :—				
Refined and Candy	430	59	3,150	445
Total	430	59	3,150	445
FOREIGN AND COLONIAL SUGARS :—				
Refined and Candy	40	1	439	6
Unrefined	2	64	55	278
Various Mixed in Bond				
Molasses	59	—	539	
Total Exports	**531**	**124**	**4,183**	**737**

THE

INTERNATIONAL SUGAR JOURNAL.

No. 223. JULY, 1917. Vol. XIX.

☞ All communications to be addressed to "The International Sugar Journal," 2, St. Dunstan's Hill, London, E.C.

Cheques and Postal Orders to be made payable to "The INTERNATIONAL SUGAR JOURNAL," and not to individuals

☞ The Editors are not responsible for statements or opinions contained in articles which are signed, or the source of which is named.

The Editors will be glad to consider any MSS. sent to them for insertion in this Journal and will endeavour to return the same if unsuitable; but they cannot undertake to be responsible for them unless a stamped addressed envelope is enclosed

Notes and Comments.

The Sugar Supply.

The supply of sugar for the United Kingdom continues to be dependent on the facilities for shipping from overseas sources, as well as on the success or otherwise of sugar cargoes running the gauntlet of the U-boats. The latter have had their successes as well as their failures; and it was recently given out by a member of the Government that we had lost within recent months 40,000 tons of sugar through enemy action Cuba has to all appearance been our main source of supply, as scarcity of shipping has tended to make the transport of Java sugar from the east a matter of difficulty. It is a better policy to send ships the shorter voyage to the West Indies than the longer one to Java; so sugar from the latter country is necessarily held up till the shipping shortage is rendered less pressing.

However, there is sufficient sugar coming into the country to enable the consumer on the whole to get his rations; some districts inevitably get better supplied than others, and the papers contain at intervals complaints as to the shortage. But the average consumer has realized by now that things cannot be normal during the war, such as he was prone to conclude up to a year or so ago, and he takes things more philosophically. He is resentful of any attempt at profiteering, but then sugar is not one of the items of food that come within the food profiteer's range of operations. Newspaper complaint has indeed centred of late rather on the fact that there was insufficient provision made by the authorities for supplying the raw material (in sugar) for domestic jam making and fruit preserving. The Royal Commission cannot plead that they have been taken by surprise. The need was voiced as far back as last winter. They have made at the eleventh hour a serious effort to supply preserving sugar to those domestic jam makers who grow their own fruit; but, as the *Times* points out with justice, they have never understood from the first how much jam is habitually made at home and how greatly home-made jam is preferred to that made by the manufacturers. As a result when they did invite applications for preserving sugar about the middle of June, they were overwhelmed with requests, and out of some 750,000 they received could only deal with half a million, and these only got 75 per cent. of the sugar they asked for. The sugar was distributed to the applicants through the ordinary wholesale and retail channels, the dealers buying it at 53s. 9d. per cwt. and the grocers retailing it by special arrangement to the local applicants at 6½d. or in some cases 7d. per lb. There is no means of knowing what proportion if any of this half million are fraudulent claimants who do not grow fruit; but some effort was made to eliminate this class by sending the sugar mainly to rural districts. Assuming the bulk of the number were genuine growers of fruit, we have only to add the possibly larger number of households who make their own jam from fruit purchased elsewhere, to get some idea of the extent to which domestic fruit preserving holds sway in British households.

Impurities in Raw Sugar.

In our last issue, we commented on the statements made in Parliament as to the impurity of certain raw sugars imported mainly from Cuba, and expressed the opinion that more sugar was going through the refineries than was necessary. This criticism was to be found also in the daily press and was emphasized by Parliamentary speakers. But it has now to be admitted in justice to the refiners that, whatever may be the case as to the purity of some consignments (which we still think might have been allowed to go into direct consumption), there have been too many others coming from Cuba containing a high percentage of physical impurities, which certainly justifies the decision to refine them. Apart from that, the sugars have at times arrived in solid blocks, showing that they had been bagged hot. That dirty bags have been used in some cases appears undeniable on the evidence. And the proportion of physically tainted sugar which has been sent over would appear to have been considerably higher than one would be led to expect from Cuban sugar centrals.

In view of the degree of publicity which Cuban sugars have received of late in the British Parliament, it seems highly desirable that the explanation of the Cuban manufacturers should be forthcoming, if Cuban sugar is not to acquire a bad name amongst British consumers. One point that will need elucidating is as to whether the sugar sent over to this country was so dispatched in the understanding that it was in any event to go to the refineries. For if the manufacturer knew that there was no question of his product being put into direct consumption he might feel justified in ignoring the presence of the physical impurities, having regard to circumstances which may have held at the time. But in view of the fact that the best Cuban crystals are usually pure enough to warrant dispensing with refining, especially when the refining output is not equal to the demand, the recent faulty shipments certainly seem to cast unnecessary reflection in the eyes of the public here as to the quality of the sugar the modern Cuban centrals can turn out, and it would be in the interests of the Cuban manufacturers to clear up the misapprehension, unless indeed they are content indefinitely to cater for the refineries, and have no desire to turn out direct consumption sugars.

We need hardly add here that we are not joining issue with those who would eliminate the refiner altogether. Admittedly, the trend of improvement in raw cane sugar factories of late years has been, and will increasingly be in the future, towards the production in the raw sugar central of a product which can be sold for direct consumption. Such sugar will command a higher price than will the lower refining grades, hence the sugar manufacturers will have some inducement to turn out the purest quality they can. But this is not the purity of the refined article, and there will always be a demand for the latter for table use and for preserving, which is not likely to be lessened by a wider acquaintance with the "plantation white" grade. The rôle of the latter will be mainly for cooking, both domestic and trade. The real point of recent criticisms has been a fairly well founded belief (as we have assumed) that the existing shortage of sugar has been increased by the delay that has arisen through the decision to refine certain raw sugars which were, in the opinion of many, fit under the circumstances to be sent into direct consumption. The proportion may not have been so great as has been alleged, but it does appear to have existed; and in view of the urgent need of sugar for domestic purposes, the complaints in Parliament and elsewhere would seem to have been justified.

Notes on American Sugar Production.

(From our American Correspondent.)

Since the date of my last previous letter, public attention and public interest have been centred upon the preparations being made for the United States to take an active part in the war. Although there was ample warning that this country might be forced to join the conflict on the side of democracy, practically nothing was done in the way of adequate preparation to put an effective military force promptly into the field. Fortunately, the navy is always ready and has been able to begin its share of the task without delay, but beyond this the whole vast work of mobilizing the resources of the nation has had to be put under way.

It must be said that reasonably good progress has been made, considering the amount of legislation that the Congress has had to put through in order to start the wheels turning. Extensive credits for the Allied nations have been arranged, food production has been stimulated, the various industries are rapidly being organized on a war footing, a loan of $2,000,000,000 to meet the initial expenses of the war has been subscribed, and 10,000,000 men between the ages of 21 and 30 have been enrolled as a first step toward the creation of a substantial fighting force. By the time this letter is published a number of other important steps certainly will have been taken, including probably the adoption of a Revenue Bill designed to add from $1,500,000,000 to $1,800,000,000 to the annual receipts of the Federal Treasury, and the organization of the food administration, along lines calculated to conserve our own supplies and to enable us to respond more efficiently to the needs in this direction of those on your side of the Atlantic whose cause we have espoused.

The sugar industry has gone its way with very little disturbance thus far. The industry has contributed its quota of men to the various new activities called into being by the war, and has been a generous supporter of the "Liberty Loan," but these things are counted as part of the day's work, and have not interfered appreciably with the ordinary course of business. A committee to represent the sugar producers and to work in co-operation with the Council for National Defence, the Department of Agriculture and other branches of the Government, is now being organized, and in numerous ways the sugar trade is preparing to do its bit.

It is realized that as the war progresses it is bound to have a marked effect upon the sugar industry, and two of the measures now under consideration by Congress are of very direct interest to members of the sugar trade. These are the

Food Control Bill and the Revenue Bill, both of which are likely to become law within the next few weeks.

The Food Control Bill is intended to create the post of Food Administrator and to give the President, through this official, very sweeping powers to regulate the distribution and, if necessary, the price of food products. It is already announced that the position of Food Administrator will be filled by Mr. HERBERT C. HOOVER, whose name probably is not altogether unfamiliar to your readers through his work as the administrative head of the Belgian Relief Commission since the beginning of the war. Mr. HOOVER is already at work preparing to set the machinery of his new office in motion as soon as he is authorized to do so. From statements which he has made it is evident that he will give early attention to cereals—particularly wheat—and to sugar. He regards flour and sugar as the two food commodities of which our European Allies are most urgently in need. While there are ample supplies of sugar in sight for home requirements and no necessity exists for any limitation of consumption if domestic needs alone are considered, it is probable that some regulation of the distribution of supplies will be introduced in order to make possible an increased volume of exports. Just what lines such regulatory action will follow is, of course, not yet determined.

As usual sugar is not being overlooked in the proposals for new taxation. The House of Representatives, which initiates revenue legislation, has passed its Bill which provides, among a large number of other imposts, for a 10 per cent. *ad valorem* duty on all imports. This would be in addition to the existing tariff and on the basis of present prices would amount roughly to an increase of half a cent in the duty on Cuban sugar.

The Finance Committee of the Senate which has been deliberating on the House Bill for the past fortnight has introduced very extensive changes in it. It proposes to reject the 10 per cent. tariff duty and to substitute for it, so far as sugar is concerned, a direct Excise tax of half a cent a lb. applying to all sugar, domestic and imported. It recommends also the removal of the drawback provision of the existing tariff law under which the duty on imported sugar is remitted when this sugar is re-exported. As all refined sugar shipped to your market heretofore has benefited by this provision of the law, the present proposal would have the effect of increasing the price of such sugar in future by the amount of the Customs duty or virtually a cent a lb. As it is no part of the policy of the Government to increase the burdens of its Allies in the war it is regarded as probable that this clause of the proposed Bill will be dropped before final action is taken.

The proposed consumption tax on sugar must be submitted to the full Senate, and if the recommendation of the Finance Committee is adopted it must then go before a Conference Committee made up of three members from each branch of Congress. Sentiment in the House of Representatives is strongly against "breakfast table" taxes, so that it is not at all certain that the plan for a consumption tax will prevail; but that additional taxation will be imposed upon sugar, either through an increase of the Customs rate or through an Excise tax, is tolerably sure.

Fortunately, the outlook for this season's Cuban production has improved steadily since my previous letter, and the final output is now estimated by the Cuban Government at 2,800,000 long tons. It was feared for a time that the crop would not exceed 2,500,000 tons, but the collapse of the insurrectionary outbreak in Cuba and favourable weather during the past two months have presented an opportunity of which the Cuban mills have taken full advantage.

Notes on American Sugar Production.

Although grinding is still under way in Hawaii and Porto Rico, it is possible to present fairly accurate figures as to the ultimate crop yield for the 1916-17 season from the various producing areas of the United States.

These figures in long tons are as follows:—

Beet sugar	730,000 tons.
Louisiana and Texas	271,000 ,,
Hawaii	565,000 ,,
Porto Rico	434,000 ,,
	2,000,000 ,,

This gives a total domestic production of 2,000,000 tons exclusive of the Philippines. The Philippine crop, according to a recent cable report from the Governor-General, is estimated at 370,000 tons, including all grades of sugar, but of this not more than 170,000 tons is expected to reach this market. It will be seen, therefore, that the United States, *thanks to its policy of encouraging home production and extending preferential treatment to Cuba*,[1] is fairly well supplied with sugar for the current year. The outlook for next year, so far as it can be determined at present, is for a considerably increased production from domestic sources. Beet plantings, just completed, are over 100,000 acres in excess of last year.

New York, June 7th.

The Extraction of Sugar from Final Molasses.

Two Rejoinders to Dr. Geerligs.

(1) By J. N. S. Williams.

In the April number of the *International Sugar Journal*[2] Dr. Geerligs gives consideration to my announcement at the annual meeting in 1916 of the Hawaiian Sugar Planters' Association[3] wherein I described certain experiments which had been conducted on solidified molasses, and certain results in the extraction of sugar therefrom which had been obtained, and ventured on the statement "that it is not the glucose, gums or ash in the molasses, which either singly or in combination prevent the sucrose therein from crystallizing, but solely the water present."

This is a working hypothesis to account for certain facts as observed here.

"Molasses theories," established for some time, refer to "saline co-efficient" as having great influence on the crystallization of sucrose present in molasses, but it must not be forgotten that all the "molasses theories" heretofore published refer to a solution of sugar, glucose, gums, etc., in which water is present in greater or lesser quantities.

To my knowledge, and previous to my announcement in December, 1916, no one had ever observed or published the fact that in the absence of water, sucrose will crystallize out of a compound of sucrose, glucose, gums, and ash. Dr. Geerligs himself, in his excellent work on "Cane sugar and the Process of its Manufacture in Java," (second edition, 1903, chapter VII, "Exhausted Molasses," page 88) makes the following statement: "It is true that after higher concentration more sugar crystallizes, but this takes place in such a form that it cannot be separated."

If this was a true statement in 1903 it is true now, and I have shown that it is true that after greater concentration, more sugar crystallizes in molasses to the extent that when all the water is removed from a mass of molasses, such as produced in this territory (Hawaii), the whole of the sucrose present will crystallize in a grain visible to the unaided eye, and furthermore, that by proper manipulation and equipment, at least half of the sucrose can be recovered as a marketable product.

---

[1] The italics are ours.—Ed, *I.S.J.*

[2] Page 159.

[3] *I S J*, 1917, 90

Dr. GEERLIGS had a glimmering of this truth when he published his work in 1903, but was blinded by the reflection that the sugar thus crystallized could not be separated from the molasses.

Established "molasses theories" lead one to a point beyond which no progress can be made in the recovery of sugar from molasses; the working hypothesis which he condemns gives reason to believe that a further important recovery of sugar from the present grades of molasses can be made, and if this be true, all "molasses theories" for "scores of years" are obstructionist in their tendency and lead the manufacturer to a false belief that all that can be done has been done, whereas the contrary is the fact.

But Dr. GEERLIGS is quite wrong when he thinks that all that has to be done to recover sugar from final molasses is to evaporate such molasses to a water-free condition; that is only the first operation. Further operations and a special separating centrifugal machine are required to complete the recovery of sucrose.

So far as it has been developed, the new process requires the same number of men, less steam and less expensive machinery to reduce high grade molasses to an exhausted molasses with a recovery of over three per cent. more sugar from the original juice than the present system, which involves the use of crystallizers, storage tanks, and ordinary centrifugal machines; hence a ton of sugar manufactured by the new molasses process will cost less than one manufactured by the ordinary process.

I will go so far as to claim that, from results obtained, I believe that a final molasses of not more than 20° purity and 17·5 per cent. sucrose can be produced by the use of the new process. Isolated experiments have shown the probability of this being accomplished in the near future.

Dr. GEERLIGS closes his communication with an extraordinary statement, which I would ask him to confirm. He says that by methods which he has developed and published, there may be produced a mixed massecuite of 60° purity and 98° Brix, which can be centrifugalled in common Weston centrifugals. Such a massecuite in our experience here would be solid, and could not be worked up for the recovery of sucrose without the application of special machinery, the use of which for such purpose forms the basis and claim upon which patents issued to me in various countries have been granted.

(2) By NOËL DEERR.

In the *International Sugar Journal* for April last, Dr. GEERLIGS criticizes the process recently put forward by Mr. J. N. S. WILLIAMS for the extraction of sugar from final molasses[1] Amongst other points Dr. GEERLIGS bases his remarks mainly on Mr. WILLIAMS' claim that it is *solely the water present* in molasses that prevents crystallization, and I agree with him so far as to say that I am of opinion that Mr. WILLIAMS has expressed the rationale of his process somewhat unhappily; and yet my interpretation of what actually happens in his process is not at variance with Dr. GEERLIGS' classic theory of molasses formation.

If, for example, we had a syrup of sugar and water only, any molasses formed would be strictly and solely due to the water; with non-sugar also present some water must be left in the massecuite to keep the non-sugar in solution, and loss of sugar may be attributed to the water or to the non-sugar, dependent on the point of view.

---

[1] *I.S.J.*, 1917, 90.

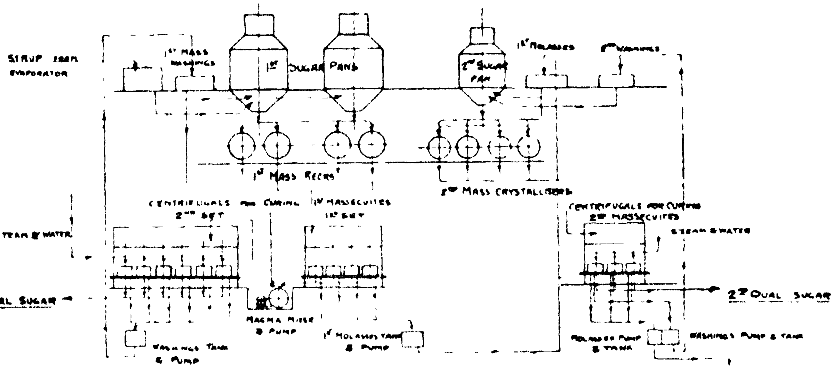
Now, Dr. GEERLIGS' theory postulates the existence of an organic potassium salt-sucrose-water complex ; if a real final molasses be evaporated to dryness, this complex body must break up and there will result potassium salt and sucrose existing independently, since water is necessary for the formation of this complex. On restoring the water to the dry molasses eventually the potassium salt-sucrose-water complex will be reformed; but I think that a definite time interval will be required, so that it might be—and according to Mr. WILLIAMS' experience is—possible to separate some of the crystals of sugar before the potassium salt-sucrose-water complex has had time to form.

As regards the commercial economics of the process, I do not care to express any opinion.

Double Curing Systems in the Centrifugal House.

By FRANK COXON.

The term "double-curing" is often used quite erroneously in connexion with the manufacture of both white and 96° test crystals, and the diagrams reproduced on the accompanying pages have been prepared to give a clearer conception of the methods adopted when these sugars are "double-cured." Primarily the words "double-curing" were and are exclusively now used by those who understand the process, to designate the double or fractional treatment given to first white sugar massecuites at the centrifugal station. So-called "double-curing" in connexion with the manufacture of 96° test crystals is the returning of the second sugars to the first centrifugals for curing along with the first massecuites, the second sugars thereby getting a double curing.



EXPLANATORY DIAGRAM OF THE DOUBLE SUGAR CURING PROCESS FOR WHITE SUGAR.

Referring to the "white sugar" diagram it will be seen that there are two distinct sets of machines for the curing of the first massecuites, separated by a mixer and pump. The first massecuites from the receivers under the pans is introduced into the first set of machines where the bulk of the mother-liquor is removed. The partially cleansed crystals are now delivered by conveyor to a mixer and worked up into a magma with a superior class of washings as the dilution liquor, these washings being obtained from the second set of machines where sugars have been previously treated. This magma or re-formed massecuite is then pumped to the second set of first massecuite machines, washed and steamed, the washings being kept separate from the first molasses or runnings from the first machines.

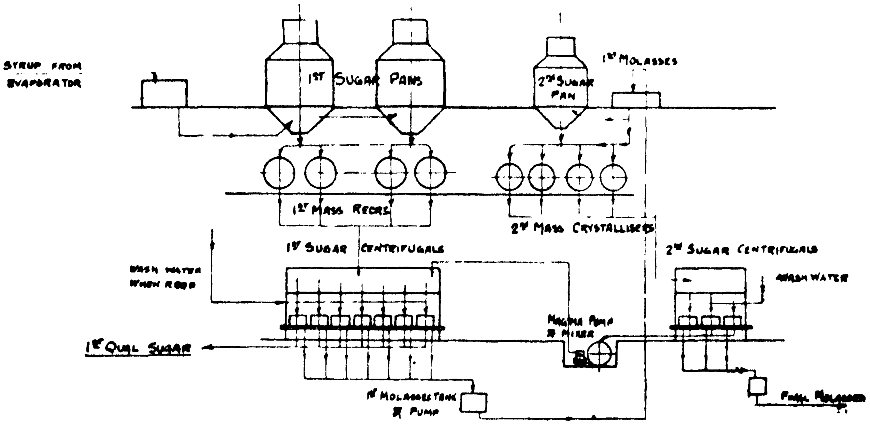
These washings are naturally of high quality, and yield a first-class product, being entirely free from contamination with molasses or mother-liquor, and the system when provided with the proper proportion of machines and equipment is said to yield in many cases quite 10 to 15 per cent. extra in first sugars, with a proportionate amount less in molasses sugars. One of the disadvantages is however that more pan power is necessary to work up these separated washings, and tank space for storage is no small question.

The purpose of double-curing in respect to white sugar manufacture is often misunderstood, like the use of crystallizers ; its object is not to increase the weight of sugar per ton of cane ground, but to yield a larger proportion of better quality crystals, the lower grades being reduced thereby in quantity.

Alternative methods of introducing the partially cleansed crystals from the first machines to the pugmill or mixer over the second curing set are employed, chain elevators being sometimes used. In many cases the double-curing process is adopted on the molasses sugars as well as on first massecuites, notably in Java and Louisiana, the extra yield undoubtedly proving the advantage, but existing factories are very difficult to transform into modern ones using these economical and highly efficient methods.

DOUBLE CURING IN 96° CRYSTAL MANUFACTURE.

A process very much used now is the manufacture of only one grade of sugar to yield a product polarizing 96° to 97°, and first adopted extensively in Cuba ; it is known as the two-massecuite system.



EXPLANATORY DIAGRAM OF THE ONE QUALITY SUGAR CURING PROCESS INVOLVING DOUBLE CURING OF THE SECOND SUGARS FOR 96° TEST CRYSTALS.

First massecuites are boiled to 80° purity, centrifugalled in the usual manner, and the first molasses re-boiled to a purity of 60.° This re-boiled massecuite is now left in crystallizers, then cured in the second sugar centrifugal, conveyed to a mixer, where syrup or first molasses from the first sugar machines is introduced, and the magma or newly-formed massecuite elevated or pumped up to the mixer over the first sugar centrifugal, and thus mixed with the first sugar massecuites. It will be seen that the molasses sugars thereby are "double-cured," and the whole contents of the mixer yielding one quality sugar.

The purity of the molasses is naturally high, about 36°, which has not resulted in a more general adoption of this process, but what is now being done is to use a three-massecuite system, where massecuites of 80°, 70°, and 60° are boiled, the first two being cured separately, whilst the massecuite of 60° purity undergoes a treatment exactly as described in the two-massecuite system, being returned to first sugar centrifugals for "double-curing." The dry sugars from the 70° and 80° purity massecuites, into which have been worked these molasses sugars from 60° purity massecuites, are mixed dry in the sugar stores.

This system gives a final molasses of much lower purity, generally about 30°, and a much more even grain than the two-massecuite system, although of not such even grain as the usual method of boiling and curing each quality strike separately. Since most 96° test crystals are however purchased on test, very little complaint is heard.

Special circumstances demand sometimes a better quality crystal, and the common practice, preferred still by many, of mixing the molasses sugars with syrup, and returning to the pans as seed for first sugar, is resorted to, the mixing being done in some cases at ground level in a remelting pan, and pumped to the pan platform, or elevated as dry sugar and mixed on the pan platform.

The drawing-in of dry sugar to the pan does not find much favour, due to the accompanying vibration and air leakage.

Some Minor Features of Evaporator Design and Operation.

By JAS. HAMILL.

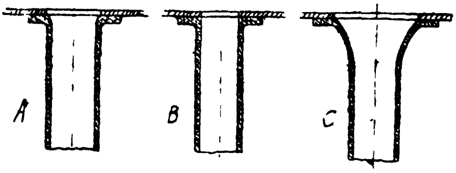
It is ever the object to engineers to design and operate apparatus at its maximum capacity and efficiency, and while it is an old saying that the weakest link determines the strength of the chain, the weak links in the chain of operations of a vacuum apparatus are not always apparent at first sight. The following are a few of the minor features in the design and operation of effect evaporators, which, frequently, are insufficiently considered.

CALANDRIA DRAIN OUTLETS.

These should be designed to allow of the condensate flowing freely from each calandria, as, if it be allowed to "bank up," part of the heating surface is covered by water. The heat transmission from water to a metallic surface is less than from steam to a similar surface, therefore a diminution of the evaporative capacity frequently results. Where the evaporator is worked with tubes "flooded" for the greater part of their length, this accumulation of water is not a serious matter, as has been experimentally determined by KERR. This has not been explained, but is possibly on account of the fact that, as the writer has elsewhere pointed out, the liquor in a vertical evaporator tube is not in a state of ebullition throughout its entire length when operated "flooded," the liquor at the lower end simply flowing up the tube and having its temperature raised until it reaches the zone of ebullition, which is at an indeterminate position in the tube. The heating in the lower end is, therefore, governed by the rate at which the liquid can take up head, and it is possible that this rate is less than that from the condensate to the tube at the same point.

With evaporators worked "low down" the conditions are different however. Worked thus, ebullition will commence partially at the lower end of the tube, and the rate at which the liquor can take up heat is *greater* than the heat transmission from the condensate. It is, therefore, desirable that the condensate be drained off to allow the steam to reach the lowest part of the tube if the full capacity is desired.

The complete drainage of a level tube plate as in a standard evaporator is impossible however, as a moment's consideration will show. If the drain be arranged to fall through a hole in the plate into the drain pipe, as shown in Fig. 1 (*A*) (and as is acknowledged to be the best practice), the flow of water over the edge will be in the form of a weir, and the depth of water may be calculated nearly enough for practical purposes by taking the perimeter of the hole as the length of the notch. As an example, take an evaporator condensing 20,000 lbs. of steam per vessel, which in the ordinary way might have a 4 in. drain pipe. The pipe would possibly be slightly bell-mounted to join to a 5 in. hole in the tube-plate giving a perimeter of say 15 in. The depth of water to produce this flow over the edge of the hole would be $\frac{15}{16}$ in., using the formula $q = 3{\cdot}3\, l \sqrt{h^3}$



where q = cubic feet per second.
l = length of notch in feet.
h = head in feet.

This formula assumes that there are no end contractions, and that the weir is straight. As, however, the hole is circular, and as there will be some end contraction effect, the height so found will be too small. In the absence of precise data it will be near enough for purposes of illustration to assume that the height will be, say, $\frac{15}{16}$ in. plus 50 per cent., say 1·4 in. As some further fall will be required to produce flow from the more remote parts of the calandria, it may be safely assumed that the mean depth of water will not be less than $1\frac{1}{2}$ to $1\frac{3}{4}$ in.

As previously stated, this will not seriously affect the working of a plant operated "flooded," but when operated "low down," the heat-receiving surface is reduced $\frac{1\frac{3}{4} \times 100}{48} = 3{\cdot}6$ per cent. for a 48 in. tube.

If, however, the 4 in. pipe were connected to a 4 in. hole as in Fig. 1 (*B*) the length of the weir would be about $12\frac{1}{2}$ in. only, and the calculated depth as above would be $1\frac{1}{16}$ in., which plus 50 per cent. gives $1\frac{9}{16}$ in. weir depth, and about 2 in. mean depth in the calandria, say 4·2 per cent. of the surface.

The provision of a large drain hole in a tube-plate reduces the number of tubes, however, and a compromise must be made. It would appear from results of tests that a 1 in. mean depth of water does not perceptibly affect the operation of the apparatus, and that this depth can be arranged for in the design. Taking the case cited above, and allowing a weir depth of 0·85 in. actual and 0·56 in. by the formula, a weir length of 31 in. will deal with 2000 gallons per hour, and will be provided by a hole 10 in. diam,, or two holes each 5 in. diam. This may be connected to the drain pipe by a suitable taper, as shown in sketch Fig. 1 (*C*).

These calculations may be readily applied to other forms of outlets than those illustrated—methods will at once suggest themselves.

Some Minor Features of Evaporator Design and Operation.

CALANDRIA DRAIN PIPES.

In the preceding it has been assumed that the extraction pump has no draining power, gravity alone being relied upon to cause the water to enter the pipe. Similarly, the size of the drain pipe should be large enough for gravity flow, and the effect of air should also be considered, as the effect of the weir entrance is likely to entrain some air down the pipe. If the velocity in the pipe be high the air will be carried into the pump and reduce its capacity. The maximum velocity which will allow the air to return against the flow is entirely a matter of experiment, and will depend on the size of the pipe. For a 4 in. pipe the pump will be quite satisfactory if the velocity does not exceed 0·5 ft. per sec., whilst for a 12 in. pipe 1 ft. per sec. may be safely allowed. These figures will be quite in order up to 27 in. vacuum.

For reciprocating pumps, both of the direct acting and flywheel types, a water receiver with a gauge glass may sometimes be necessary and at all times a convenience, as the speed may then be regulated to avoid undue steam consumption, but for centrifugal pumps no receiver is necessary if the pipes are correctly proportioned.

EFFECT OF AIR.

Leakages at Pumps.—A slight leakage of air at the isolating valves near the pump may easily be sufficient to interfere with their operation, and all glands in spindles of valves, pistons, etc., should have efficient water seals; pipe joints should also be carefully made, as quite a small leak will admit a large volume of air, which, at the valve or in the piping, will flow back the pipe to the calandria and impede the downward flow of condensate, and at the piston rod glands of a reciprocating pump will fill the pump with air in the suction stroke and cause the pump to lose its water. Trouble with drainage arrangements is frequently caused by these unsuspected air leaks, gauge glasses or water columns being particularly responsible. Since it is not usually possible to have these water-sealed, their use should be avoided where possible. For these reasons centrifugal extraction pumps are attractive, as no water columns or valves are required.

General Air Leakages.—The electric power station engineer has learnt that besides reducing his vacuum, all air which leaks into the turbine or condensers has to be removed therefrom at the cost of current, and such is the care now exercised that these leaks are frequently of the order of 0·5 lbs. per 1000 lbs. steam, against the 5 to 10 lbs. per 1000 lbs. steam usual in evaporator work. The conditions are very different, but sight windows, gauge glasses, and valve spindles are most usually leaky, as may be seen by the bubbles which rise in an ordinary gauge glass, and their numbers should be kept to a minimum where necessary. All regulating valves should have water-sealed glands with a large open cup. Sight glasses are impossible to thoroughly seal, and as they might be replaced by a large bore gauge glass having water cups at both ends of the glass, they might be eliminated altogether on effect evaporators. Sight glasses certainly add to the appearance of an apparatus, but it would seem as though they were of doubtful utility.

A further source of air leakage will sometimes be found in the pipe arrangement between the juice feed tank and the first cell. This pipe should be aranged as a "U" pipe of sufficient depth to prevent air being drawn in should the juice level in the tank be allowed to fall through careless operation.

In condensers where the water is sucked through some height, leaks are frequently serious at the spindle of the injection valve. It is important that this spindle be effectively water-sealed, and the pipe joints very carefully made.

Russian Sugar Notes.

The tone of Russian sugar industry labours of course under the depressing influence of the political situation which, like all other upheavals of the kind, whether for good or evil, has very gravely affected industry generally. The sugar business being primarily an agricultural one, that is to say, dependent for its raw material on field cultivation, the fact of the revolution having taken place in the early months of the year has told on the sowings of beetroot. It is even now impossible to say to what extent the sowings have been affected; but their position is certainly a grave one. They have been influenced not only by the hesitation that naturally accompanies exciting political events, but also by the extraordinary demands that have been formulated by the labour factor which, if acceded to, cannot but paralyse for a time the industries that have been based on normal conditions. In the course of time various economic elements in the country may become adjusted to the new conditions, but the extraordinary increases demanded by the workpeople, as well as the extra cost of moving goods, not to speak of the uncertainty of their being moved at all, have all contributed to making the value of the raw material much higher than was considered probable at the last time prices were made up for the current and succeeding campaigns.

A price had been fixed for beetroot, but it is now an impossible one; and the Russian Sugar Manufacturers' Association is firmly requesting the new Government to recognize the awkward conditions, and admit that beetroot will cost the sugar mill owners much higher prices than had been originally estimated for. Consequently, they say, if the price of sugar, that is the finished article, is to be fixed or taxed, then it must be at a much higher level than that last fixed by Government. Although the request is not called an ultimatum, it is put almost in the form of such a declaration, and appears to indicate that unless the Government can accommodate itself to the sugar interests in the direction named, a great number of factories will be added to those that have already gone out of business either under stress of German occupation or from economic conditions of a prohibitive nature.

Regarding the producing industry itself, assuming that the beet sown will be successfully harvested, there can be little doubt that putting the best face on it, the production of the next campaign will be considerably less than that of the current one, which, according to the data just issued in the capital, shows a production for the first seven months of the campaign amounting to 71,346,658 poods of both raw and refined sugars, and compares with 90,640,129 poods in the preceding campaign, and 106,110,129 poods in the campaign of 1914-15. There has been an ominously large decline in each of the past three years, to which there is little doubt a fourth must be added of a similar nature, and the difference that may be required in the country can only be made good by importations. To the amount already authorized by the Government, considerable quantities must be added; for it is simply impossible to satisfy the requirements both of the army and the people. Along with the current production and the margin that the Government has authorized to be imported, there is now to be expected a series of specific trade demands on the Government for sugar. The confectioners, for example, who have been put on short supplies by the Government in order to economize sugar for more important purposes, think that they can do better if they are allowed to import sugar on their own account, and they are asking permission to import as much as 6,000,000 poods over and above the 20,000,000 poods referred to as being authorized by the Government. Their 6,000,000 poods of course would be imported by themselves for the exclusive use of the confectionery industry. But there are other claimants who will be ready to prefer similar requests, and as it is quite understood that the supplies are going to be very far short of the demand we may be sure that a number of such requests will be granted either wholly or in part; unless, which is always possible, the Goverment may group all the extra requirements of the country, and seek to import the sugar itself and become the distributing authority.

The leading question apart from the ordinary national sugar industry is the chance there may be of developing a sugar industry in Siberia. This of course is a question affecting the future and can have no relation whatever to the present crisis. It is, however, one that is taken up by responsible people well competent to pronounce a judgment on the possibilities or probabilities of Siberia as the seat of a sugar industry or perhaps, more properly speaking, of a number of sugar industries; for in the immense area occupied by that country separated economically into a number of districts there is room for a number of industry units for which a local but yet very wide market would be available. As has been stated before, the experiments made in beetroot cultivation in various parts of Siberia have resulted very satisfactorily, whilst in the Far East on the Manchuria side sugar factories have been built on the strength of local beetroot production, and have been worked with great success: including, it may be observed for the purposes of the climatic argument, China itself, whence a certain quantity of sugar, not of the best quality however, has already reached the interior of European Russia, and further large quantities are expected to follow. At least this appears to be certain from the fact that the Moscow people have bought considerable parcels to balance the deficiency on their market.

Russian sugar, like other industries in the country, is passing through a bad time; but it will not be bad for everybody. The consumers may expect to be very severely squeezed, and a number of factories will suffer also, not so much from market conditions as from inadequate supplies of raw material which it is hardly to be hoped now can be satisfactorily delivered. Those, however, that are left—and there will be a large number, no doubt—will probably make a good deal of money and give the industry the appearance of great prosperity, and constitute a temptation to invest capital; that is on the strength of the balance sheets that they will issue at the end of the year. But it is to be feared that the only ones that will benefit are the producers and not the consumers; and probably again amongst the producers there will be, as suggested, numerous exceptions, because of physical impossibility in the matter of sugar production.

Petrograd, June 10th, 1917.

It was recently stated at a meeting at Durban that by means of the direct taxation on sugar, the Natal Government received in revenue about £45,000 per annum. From the sale of lands to Europeans the Government either had received or would receive £1,000,000, and they were now in a position to estimate that if all the land were cultivated it would yield a sugar production valued at £11,000,000 a year.

The *Times of India* states that great progress has been made in Hyderabad in the manufacture of motor spirit from the mahua or mhowra tree, which abounds in that State. Several types of motor car have been run successfully for some time on mahua spirit at half the cost of petrol. The annual consumption of petrol in Hyderabad and Secunderabad is about 100,000 gallons, and only about 1500 tons of mahua are required to make the equivalent of that quantity.

Application of the Tintometer to Sugar Factory and Refinery Control.

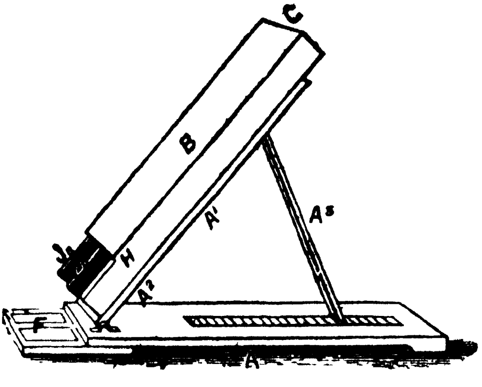
By C F. BARDORF.[1]

THE LOVIBOND TINTOMETER.

With the aid of the Lovibond tintometer very valuable colour analyses, as well as *character* determination, of any clear coloured liquid can be made. It is simplicity itself, being (as shown in the sketch) little more than an almost rectangular oblong box *B* with appropriate peep-holes *C* and a white plate *F* for reflecting the light. It can be set to any convenient angle, which, of course, must be kept constant, and must be fixed once and for all. The cells are furnished for observation through depths of $\frac{1}{10}$th to 1 in. of liquid, and a small rack placed beside the observation cell holds the coloured glasses necessary for each determination. Finally, a set of about 500 small coloured glass plates, yellow (*Y*), red (*R*), and blue (*B*) are necessary for a wide field of work. These glasses are accurately graded, and are numbered, so that if the same number of yellow, red, and blue be superimposed they produce a neutral tint or black.

LOVIBOND'S COLOUR THEORIES.

Before describing efforts to devise special methods for the particular purpose of my requirements, it may be well to give a few abstracts from Lovibond's papers.[2] "Colour standards must be available for use under ordinary daylight conditions, and for determining the colour of liquids, solids, or gases they may either be fixed points or scales, but scales have a much wider range of application. The character of the light used in preparation must be defined, both for intensity and composition. The angle of incidence of the light must be defined, and also the distance of the eye from the object of vision, the latter on account of the intensity of the light reflected, the former as causing variations in colour and intensity. . . . . In order to standardize the sensation of colour, it must be correlated to a physical colour constant for which the following have been suggested and used with more or less success: the solar spectrum, the spectrum of the arc-light, the colours of diffused daylight, pigments, and chemical solutions. The solar spectrum naturally suggests itself as a standard, and at first appears to be promising, but practical work discloses so many complications that up to the present no satisfactory results have been arrived at."



After discussing the value of these sources of light, Mr. LOVIBOND comes to the conclusion that "diffused daylight as an illuminant is free from most, if not all, the disadvantages of direct light, and has the distinct advantage that while one part of the impinging beam illuminates the object, the other illuminates the colour standard. In reading colour sensations for record, constancy is obtainable by observing certain conditions, all of which appear to be within the limits of definition. The principal points to be defined are the intensity of the light, the angle of incidence, and the degree of diffusion. In conclusion, he states this law: "The colour of a pure substance at a particular density is constant. This law affords means of checking the standard colour scales, as by matching them with pure coloured substances of known density any departure from absolute can be at once ascertained. . . . . Every substance has its own specific rate of light absorption, developing definite colour sensations for definite densities."

---

[1] In *Sugar*, 1917, 141-144, here slightly abridged See also *I.S J.*, 1917, 278.

[2] *Journal of the Society of Chemical Industry*, 1909, **28**, 500-503

His remarks on the colour of malt extracts are strictly applicable to sugar solutions, and accentuate the necessity of distinguishing so-called "colour character;" and he writes: "A wide distinction must be made between the terms 'colour depth' and 'colour character.' When we speak of malt as being 'light' or 'dark' in colour we only express our idea of the colour depth of the sensation without regard to the colour character. It is only when a number of malts, similar in colour depth, but varying in quality, are brought together, and the constituents of the colour are separated by analysis, that we realize how great a variety of colour character is found under a single expression of colour depth."

Another fact obtrudes itself, and it is this: that with a change of density, or with a change of depth of observation cell, tints alter not only in quantity, but also in quality or *character*, as LOVIBOND terms it. But such changes are peculiar in that they are not proportional to change of depth or density of solution, i.e., a solution observed through a ½ in. cell gives *less* than half the colour quantity than when observed through a 1 in. cell, and the colour character also changes to a marked degree, the percentage of red being usually higher.

EXAMINATION OF SUGAR SOLUTIONS.

Turning now to the specific purpose to which the tintometer is to be applied, viz., the comparison of various solutions of raw sugar and refinery products generally, it was found necessary to establish a rigid standard, so that one of the most valuable features of tint recording might be preserved, namely, the possibility of being able readily to reproduce the colour by colour-plate building from the records of the colour analysis once made. After a number of preliminary trials it was finally decided to work upon a 10 per cent. solution observed through a 1 in. cell, and from numerous colour analyses it was concluded that this observation standard gives the most satisfactory results, so that readings are comparatively rapid and accurate, and the tint elements are in no case eliminated. This is illustrated by the following data, which also indicate the changes of colour with change of dilution, already referred to:—

20 per cent. Sugar Solution.

	1 in Cell		½ in. Cell.	
	Reading	Per cent	Reading	Per cent
Yellow	34·00	86·5	9·80	80·8
Red	5·00	12·7	2·20	18·1
Blue	0·34	0·8	0·13	1·1
	39·34		12·13	

10 per cent. Sugar Solution.

	1 in Cell		½ in. Cell	
	Reading.	Per cent.	Reading.	Per cent
Yellow	9·8	80·8	3·5	76·0
Red	2·2	18·1	1·1	24·0
Blue	0·13	1·1	—	—
	12·13		4·6	

5 per cent. Sugar Solution.

	1 in. Cell.		½ in. Cell.	
	Reading.	Per cent.	Reading.	Per cent.
Yellow	3·5	76·0	1·5	73·5
Red	1·1	24·0	0·54	26·5
Blue	—	—	—	—
	4·6		2·04	

Further experiments, in fact, showed that excessive dilution brings about a remarkable change in the colour, both in quantity and in character.

Another question arose, namely, whether, being given two solutions of known colour composition, definite mixtures of these will yield concordant colour composition, determined and calculated. Experiment proved this not to be the case, for the calculated figure always gave a higher colour total than that determined by actual observation, the variation lying between 10 and 40 per cent., according to the nature of the liquid.

One more item had to be dealt with, and that was to find a ready method of obtaining a clear solution for tintometric observation. Small quantities of diatomaceous earth were first used, but this, and also alumina cream, was found to have a tendency to adsorb colloidal colour from the solution. Recourse was therefore had to filtering through asbestos, passing the solution through the filter several times, if necessary. This comparatively strong decolorizing effect of diatomaceous earth is well illustrated by the colour analysis of a solution before and after being shaken with about 10 per cent. of the earth (calculated on the dry solids of the sugar) :—

	Raw Sugar Solution before treatment.		Raw Sugar Solution after addition of the earth.	
Yellow	18·00	84·3	6·6	80·0
Red	3·20	15·0	1·6	20·0
Blue	0·15	0·7	—	—
	21 35		8·2	

Thus, under these conditions, about 60 per cent. of the colour was removed by means of the diatomaceous earth.

Considering the vagaries and deviations observed in tintometric measurements as indicated above, the practical application of the instrument at first sight appears of very limited value, but most of the difficulties vanish by keeping strictly to conditions laid down, so that with reasonable precautions information not otherwise attainable can be pressed into valuable service. Indeed, as compared with results obtainable by means of the Stammer colorimeter (the only one the author has had an opportunity of comparing), the application of the Lovibond tintometer is certainly wider and its results more reliable.

APPLICATION TO MILL AND REFINERY PRODUCTS.

Coming now to the practical application of tintometric analysis to mill and sugar-house products, the Lovibond instrument may be considered under four headings, viz. :—

1. Raw sugar.
2. Colour removed in process of refining.
3. Measurements of efficiency.
4. Experimental work.

1. *Raw sugar.*—The consideration of one class of raw sugar will suffice to point out the features of colour variation, and 96° centrifugal crystals will be taken.

2. *Colour removed in process of refining.*—It will be quite evident from the inspection of the following analyses that for unity of refined material, an appreciably greater quantity of colour will have to be removed in some cases than in others. Taking, for example, the two extreme cases of No. 1 and 2, there is 60 per cent. more colour in 1 than in 2, and it will also be noted that in 1 and 2 there appears almost double the amount of blue than in 3 and 4. This fact in the experience of the author seems to indicate that more colloidal colour has to be dealt with in those sugars showing a relatively high percentage of the blue element in their colour constituents.

	No. 1.	No 2.	No. 3.	No. 4.
Polarization	96·2	96·0	96·2	96·2
Invert sugar	0·79	1·42	1·35	1·59
Water	0·90	1·25	0·65	0·70
Ash	0·46	0·51	0·48	0·52
Undetermined	1·65	0·82	1·32	0·99
Yellow, degrees	62·0	38·0	54·0	49·0
Red, ,,	27·0	17·0	18·0	18·5
Blue ,,	5·6	3·4	1·5	3·2
Total ,,	94·6	58·4	73 5	70·7
Yellow, per cent.	65·6	65·1	73·4	69·3
Red, ,,	28·5	29·1	24·5	27·6
Blue ,,	5·9	5·8	2·1	3·1

If an average sample be prepared of all grades of raw sugar refined during a certain period, and another of the refined products during the same period, the tintometer may be relied upon to give very definite indications as regards colour removal during that period.

	Raw Sugar.		*Refined Products.*	
	Reading	Per cent.	Reading.	Per cent,
Yellow	20·50	80·0	0·58	85·0
Red	4·60	18·0	0·10	15·0
Blue	0·70	2·0	—	—
	25·80		0·68	
Total colour removed, per cent.			99·36	

Further, by being able to build up from the records by means of the glass plates the colours of raw and refined products of a previous period, comparisons can be made of the results obtainable from a certain class of raw material, for what they have yielded at any period they may be expected to yield at some future time. In short, there is always to hand a permanent record of past operations, mathematically tabulated, and visually presentable at any moment. Obviously, convenient records of the colour quality of the finished products are always desirable, and where standard articles are constantly being produced, a practically imperishable standard can easily be provided for comparision.

3. *Measurements of Efficiency.*—For checking the general efficiency in the different steps of refining operations, the tintometer can be made to correct the fallible eye-judgment of even the most experienced workmen. Methods can readily be devised to suit the special requirements of any establishment.

4. *Experimental work.*—In no other line of work has the tintometer been more valuable or furnished more interesting data, than in experiments more or less directly connected with actual sugar-house operations. In the first order of importance is the determination of the filtering value of a particular bone-black, which may be in the battery of filters, or is about to be used by itself or in

conjunction with other working chars. But the great question primarily is: What is good char? Or, given two chars, which of the two is the better? Unfortunately there is no single factor of quality, nor several combined factors to definitely answer this question. Indeed, unless one of the commonly recognized qualities of a char is decidedly below the normal, it is almost impossible by the data before one to decide in the favour of one or the other.

Comminution, apparent specific gravity, and chemical analysis should of course be considered, and a velvety lustre is always a good characteristic; but one may be led astray even when all these factors look normal. Therefore, experimental filtration is the final and deciding proof of the relative efficiency of a char, and the tintometer distinguishes differences in this operation quite undetectable by the unaided eye.

Three pairs of chars were tested as to their filtering qualities under absolutely uniform conditions, and similar chars were operated upon simultaneously, that is in pairs, making three filtrations in paired experimental filters. The entire course of filtration proceeded along standard lines, previously laid out, which had been followed on many former occasions. Colour analyses were made throughout on solutions of 55° Brix in the ¼ in. cell. These six chars were designated:

A1	....	S1
A2	....	S2
A3	.. .	S3

the numbers indicating that this pair of chars is similar in composition. Filtration was made simultaneously on each pair.

Sets of comparative filtrations were made through cylindrical filters 13 in. × 6 in., containing 5 kg. of char, 7200 c.c. of raw liquor at 55° Brix (equal to 5 kg. of solids) being run upon the surface of the char at the rate of 600 c.c. per hour. The rate of settling was therefore from 4–5 hours, according to the apparent gravity of the char.

After the liquor had been run on, water followed at the rate of 300 c.c. per hour until 6650 c.c. of the filtrate had been gathered as liquor and 1050 c.c. as sweet-water. The speed of water flow through the char was increased to 1200 c.c. per hour, and maintained until 3500 c.c. of the filtrate had been collected as waste water. During the passage of the liquor and the first 1000 c.c. of water, the temperature was held at 83° C. (181° F.), and then raised to 85° C. (185° F.), at which point it was maintained until the end of the experiment. The original raw liquor gave the following colour values:—

Original Raw Liquor.

	Reading		Per cent.
Yellow	38·5	....	68·6
Red	16·0	....	28·5
Blue	1·6	....	—
	56·1		

While those for the 6650 c.c. of raw sugar liquors treated by the three pairs of chars were as follows:—

	Liquor from Char A1		*Liquor from Char S1*		*Liquor from Char A2.*	
	Reading	Per cent	Reading	Per cent.	Reading.	Per cent.
Yellow	1·25	79·6	1·05	81·4	9·60	83·1
Red	0·32	20·4	0·24	18·6	1·95	16·9
Blue..	—	—	—	—	—	—
	1·57		1·29		11·55	
Colour removed, per cent.	97·18		97·70		79·41	

	Liquor from Char S2. Reading.	Per cent.	*Liquor from Char A3* Reading.	Per cent	*Liquor from Char S3.* Reading	Per cent.
Yellow	2·00	74·6	9·60	84·2	6·20	83·8
Red	0·68	25·4	1·70	14·9	1·10	15·0
Blue	—	—	0·10	0·9	0·10	1·2
	2·68		11·40		7·40	
Colour removed, per cent.	95·22		79·6		86·8	

The carbon content and the specific gravity of these chars were as follows:—

	Carbon content. Per cent	Specific gravity.		Carbon content Per cent	Specific gravity
A1	8·25	0·8919	S1	11·20	0·8525
A2	10·48	1·1551	S2	8·02	0·9302
A3	8·10	1·1738	S3	9·42	0·9849

For some years the writer has been experimenting upon a decolorizing black, which, it was believed, might be useful as an auxiliary to bone black filtration. Its decolorizing power had frequently been determined. It had been used for refining purposes without the subsequent aid of bone black, but certain technical difficulties soon indicated that its value would be restricted to auxiliary work with bone black. The following figures are typical of several groups of experiments made in decolorization by means of this black alone, and also supplemented by bone black. A raw sugar solution was prepared by defecation in the usual manner, and made to a density of 55° Brix, the liquor thus made giving the following colour analysis before and after treatment:—

	Original Liquor. Solution A. Reading.	Per cent	*Treated by the decolorizing black. Solution B.* Reading.	Per cent.
Yellow	77·0	86·0	38·00	88·3
Red	11·50	12·8	5·00	11·6
Blue	1·00	1·2	0·05	0·1
	89·50		43·05	
Colour removed, per cent.			51·5	

Standard filtrations, as already described, were next made with equal volumes of Solutions A and B, and the resulting filtrates tintometrically examined:—

	Solution A, after filtration. Reading.	Per cent.	*Solution B, after filtration.* Reading	Per cent.
Yellow	2·70	81·8	2·20	81·5
Red	0·60	18·2	0·50	18·5
	3·30		2·70	
Colour removed from the original liquor, per cent.	96·3		97·0	

Apparently the effective work that the decolorizing black had done on Solution A in producing Solution B was almost entirely lost after having passed through the bone black. This result, considered in connexion with the first one with the decolorizing black, incidentally demonstrated the value of the decolorizing black as a bone black auxiliary, and also showed that exhaustion of the char is much slower when acting upon liquors treated with decolorizing black: in other words, that either less bone black is necessary to obtain a definite total decolorization, or, what amounts to the same thing, a greater volume of liquor may be put through a unit weight of bone black. This was amply demonstrated by another experiment, in which a raw sugar liquor was prepared as before, namely by defecation in the usual manner, and adjusting to a density of 55° Brix, giving on colour analysis;—

	Solution C.	
	Reading.	Per cent.
Yellow	45·50	79·0
Red	11·50	20·0
Blue	0·54	1·0
	57·54	

After decolorization by the decolorizing black, the colour readings were:—

	Solution D.	
	Reading.	Per cent.
Yellow	18·00	86·1
Red	2·80	13·3
Blue	0·10	0·5
	20·90	

Colour removed, per cent. .. .. 63·6

A unit volume of Solution C was then filtered through 100 per cent. of bone black (calculated on the total solids in the sugar solution), while a unit volume of Solution D was simultaneously filtered through 66 per cent. of bone black, the resulting filtrates being colour-analysed, giving:—

	Solution C.		Solution C.	
	Reading.	Per cent.	Reading.	Per cent.
Yellow	3·00	79·4	3·10	80·0
Red	0·78	20·6	0·78	20·0

As a last word, it may be added that though the tintometer may be operated in fairly uniform daylight with the results indicated, the observations require considerable care, and must be carried out systematically by one person, or two in collaboration, if comparisons are to be the most trustworthy obtainable. It will be readily understood that the personal equation is a factor of some importance in these observations, and that a trained eye is always desirable.

The Effect of Lime in Cane Cultivation.[1]

By W. E. CROSS, B.Sc., Ph.D.,
Director and Chemist, Experiment Station, Tucumán.

Experiments carried out in many sugar countries have shown that the application of lime to the soil is beneficial. In British Guiana,[2] for example, a cycle of experiments lasting 13 years has shown an average annual increase of 8 tons of cane per hectare, produced by the application of lime and fertilizer, and of 7 tons produced by the application of lime alone. As a result of many other experiments in the same country, HARRISON[3] says:—"The use of lime produced a large increase in the rendement of cane."

In Hawaii also the application of lime has been found beneficial, especially in conjunction with fertilizers. In fact, Mr. ECKART, Chief of the Hawaiian Experiment Station, says:—"These applications are absolutely necessary in certain cases, above all in acid soils, because there is considerable risk in applying fertilizers, such as ammonium sulphate and potassium sulphate, without having previously applied lime."

Speaking of Antigua and St. Kitts, Mr. DUNLOP[5] states that there beneficial results were obtained from the application of good quantities of lime.

In Egypt also, the application of lime has proved very useful in the cultivation of cane. Mr. WALTER TIEMANN, author of "The Sugar Cane in Egypt," says that in many experiments he proved that applications of lime to the soil were of benefit. In fact, in the case of heavy, black soils, he recommends a trial of lime to test its effect.

---

[1] *Revista Industrial y Agricola de Tucumán*, 1916, 7, No. 5, 173-178. [2] *West Indian Bulletin*, II, 6. [3] *Ibid.*, XIII. [4] *Bulletin*, 29, S H.P.A. [5] *West Indian Bulletin*, XV, p. 220.

The benefits produced by the application of lime have been noted in almost every kind of crop, and especially in heavy, acid soils with poor lime content. These benefits are due without doubt, in certain cases, to the need which the plants have of the lime as a food. Nevertheless, in general, the beneficial effect of the applications of this fertilizer is due almost entirely to an improvement both physical and chemical of the soil, which results from the liming. The causes of the improvement may be divided as follows:—

1. The lime makes the clay shrink, thus facilitating the entrance of water and air, and transforms the large compact lumps into small particles. In this way such soils become looser, do not dry or pack, and, therefore, the work of ploughing and cultivating is made much easier, and the soil generally becomes a more healthy medium for the growth of the plants.
2. The lime neutralizes the acidity of the soil, giving a neutral or somewhat alkaline reaction, which is ideal for the plants.,
3. The lime helps the plants to assimulate the potash of the soil.
4. The presence of lime is necessary for the proper development of many beneficial bacteria which exist in the soil, because it produces a neutral or somewhat alkaline condition, which forms the most suitable ambient for the micro-organisms. The lime favours the decomposition of the organic matter of the soil, and prevents the accumulation of the poisonous substances which are harmful to the growth of the plants.

The general improvement of the soil is very probably the principal reason for the benefit which results from the application of lime to cane lands, for sugar cane, which is not a calciferous plant, depends little upon lime for its nourishment.

One of the practical effects of the use of lime is that it makes the application of commercial fertilizers more efficacious. This is due, undoubtedly, in part to the general improvement of the physical condition of the soil, as well as to the specific effect of the lime in facilitating the assimilation by the plants of the potassium, and in fomenting the decomposition of the organic matter. These practical benefits have been demonstrated frequently, especially in Hawaii where the use of fertilizers is so common, and where, in conjunction with commercial manures, lime is applied at the rate of one ton per hectare, or even more in the case of heavy soils.

The question of the application of lime is of special interest in Tucumân, where so many of the soils have notably low contents of this element. The analyses of the soils of this Province, published by the National Department of Agriculture,[1] also those which have been made by this Station,[2] indicate very clearly that, in many cases, both the soils and the sub-soils contain little lime, from which it is to be inferred that the application of lime would be beneficial in the cane fields.

Moreover, the necessity of applying lime to the soils may explain in a certain degree the almost negative results which so far have always been obtained from fertilizer experiments in this Province. Considerations of this nature induced the Station several years ago to start an experiment to test the application of lime alone, as well as its application with fertilizers. This experiment gave definite results, showing the advantages to be derived from the lime, as will be seen from the following description.

---

[1] Contribución al Estudio de los suelos de la Republica Argentina. LAVENIR Y MORMOS.

[2] *Revista Ind. y Agric. de Tucumán*, II, 506

The experiment was started in 1911 by Messrs. HALL and ROSENFELD.[1] A lot was ploughed (share and sub-soil ploughs) and thereafter harrowed. Lime was applied to half the land, the other half being left as a test plot. The lime was applied at the rate of 1600 kg. per hectare, in the following manner. Small heaps of lime were distributed over the surface of the sub-lot, and left to slake in the air and rain. Later, the lime was spread over all the sub-lot by means of the tooth harrow.

Each sub-lot, that with lime and that without, was divided in two parts, one of which in each case received an application of fertilizer—a normal amount of complete fertilizer. The fertilizer was applied each year afterwards to the young cane, but the application of the lime was not repeated.

Therefore, the four sections of the complete lot represented:—

Without lime and without fertilizer.
Lime without fertilizer.
Without lime and with fertilizer.
Lime with fertilizer.

The cultivation of the cane during the whole five years was carried out in accordance with the usual methods of the Station. It will be sufficient, therefore, to give the following details of the progress of the experiment:—

1911, June 26. Purple native cane was planted in double row.

1911, December 30. Complete fertilizer (50 per cent. dried blood, 40 per cent. superphosphate of lime, 10 per cent. sulphate of potash), was applied to the special sections at the rate of 600 kg. per hectare.

1912, July 19. The lot was harvested.

In the subsequent years the fertilizer was applied in the same proportion on the following dates:—

November 6, 1912.
,, 3, 1913.
November 10, 1914.
,, 13, 1915.

The cane was harvested as follows:—

First year stubble .. .	August 20, 1913.
Second ,, ,, ...	July 18, 1914.
Third ,, ,, .	,, 12, 1915.
Fourth ,, ,, . ..	,, 14, 1916.

The results of the five years are given in the following table:—

		Yield, kg per hectare.	Juice Analysis				Sugar, kg per hectare.
			Brix	Sugar	Glucose	Purity	
Without lime and without fertilizer	Plant	33·200	15·4	12·0	0·4	77·9	2·161
	1st year stubble..	40·533	18·0	15·7	0·2	87·3	3·887
	2nd ,, ,, ..	30·613	18·0	15·2	0·2	85·3	2·871
	3rd ,, ,, ..	28·867	14 1	10·0	0·8	70 9	1·435
	4th ,, ,, ..	14·620	13·6	10·4	1·0	76·5	819
	Average....	29·565					2·235
With lime and without fertilizer	Plant	41·860	15·0	11·3	0·4	75·3	2·491
	1st year stubble..	44·000	18·8	16·3	0·1	86·7	4·343
	2nd ,, ,, ..	41·867	18·1	15·2	0·2	84·0	3·651
	3rd ,, ,, ..	38·600	13·6	9·7	0·9	71·3	1·864
	4th ,, ,, ..	15·380	13·7	10·1	1·1	73·7	797
	Average....	36·349					2·629

---

[1] *Revista Ind y Agr. de Tucumán*, III, 308.

		Yield, kg. per hectare.	Juice Analysis				Sugar, kg. per hectare
			Brix.	Sugar.	Glucose.	Purity	
Without lime and with fertilizer..	Plant	31·907	16·9	12·4	0·3	78·0	2·166
	1st year stubble..	44·467	18·0	15·5	0·2	86·1	4·140
	2nd ,, ,, ..	37·947	18·1	15·2	0·2	84·0	3·400
	3rd ,, ,, ..	32·200	14·3	10·4	0 7	72·7	1·713
	4th ,, ,, ..	15·047	14·3	10·5	1·0	73·4	811
	Average....	32·313					2·446
With lime and with fertilizer..	Plant	48·553	16·0	12·5	0·4	78·1	3·331
	1st year stubble..	44·800	18·4	16·7	0·2	88·4	4·641
	2nd ,, ,, ..	39·760	18·4	15·7	0·1	85·3	3·729
	3rd ,, ,, ..	31·867	14·4	10·5	0·7	72·9	1·718
	4th ,, ,, ..	14·893	13·6	10·1	0·9	74·3	782
	Average....	35·974					2·840

The favourable effects of the use of lime are seen both in the rendement of cane and in that of sugar in all the years. In the sub-lot without fertilizer, the application of lime produced an increase of rendement of 6·8 tons of cane and nearly 400 kg. of sugar per hectare per annum. In the fertilized sub-lot, the annual increase produced by the lime was, on the average, 3·66 tons of cane and 400 kg. of sugar per hectare.

Calculated on the basis of one hectare, the total production of five years is:—

	Tons of Cane	Tons of Sugar.
Without lime	154·7	11·7
With lime	180·8	13·67

This represents a gain of 26·1 tons of cane or nearly two tons of sugar per hectare, produced by one single application of 1600 kg. of lime before planting the cane.

The experiments also demonstrate clearly the usefulness of the application of fertilizers in the sub-lot without lime; the part fertilized gave 13·7 tons more cane and 1055 kg. more sugar per hectare in five years than the part not fertilized.

In the limed sub-lot, the effect of the fertilizer is not positive, with respect to the rendement of cane, but it is so with regard to the rendement of sugar, the fertilizer having produced an increase of 1055 kg. per hectare.

In general, the experiments indicate that it would be well worth while to try the application of lime in the large plantations. The lime can be obtained in the Province itself at a moderate price—$16 (Argentine paper) or less, per ton of quicklime—and therefore this method of improving the soil would not be too costly for employment on a large scale.

The Station recommends, therefore, that experiments with lime be carried out on a fairly large scale in the plantations, especially with a view of improving heavy, clayey, or acid soils. The Station cannot offer for the moment a more definite recommendation, but we believe that there exist in the Province many plantations in which the application of lime would be very beneficial.

Meanwhile, we are starting other lime experiments, especially in connexion with fertilization with artificial fertilizers.

The experiment above described was started in 1911 by Messrs. **Rosenfeld** and **Hall**, and continued up to May, 1916, under the direction of Mr. **Rosenfeld**.

It is stated that M. Terestchenko, the Russian Minister for Foreign Affairs, is a South Russian, and represents Kieff in the Duma, in which neighbourhood he has large interests in the sugar industry.

Practical Results of the Electrification of Cane Mills.[1]

By S. T. CARR.

It is evident now, seeing the number of mills that have wholly or partly been "electrified," that the use of electric power has passed beyond the experimental stage, and that the time is ripe to consider the problem from the actual results obtained, rather than from theoretical calculations. In order to promote discussion at the Convention, a summary may be made of some of the results recently obtained in a test made at the Central Florida, Cuba, and collated by Mr. E. W. KERR.

All the power in this mill is centralized in two 800-kilowatt turbine units, one of which is in service normally. The turbine supplies practically all the exhaust steam used in the quadruples, pans, and juice-heaters, any additional amount required being furnished by two house boilers generating at 110 lbs. pressure, this being reduced by two valves, one at the effect and the other at the pans. The turbines were operated at an average steam pressure of 125 lbs., superheated 87° F., against an average back-pressure of 3·5 lbs., the consumption being measured by two Venturi meters placed in the feed lines of the two boilers.

Before being clarified, the juice was heated to 210° F. by two exhaust steam juice-heaters, in which the pressure seldom exceeded 5 lbs. Tests made on three vacuum juice-heaters, which used steam from the first effect body, where the pressure was slightly above atmospheric, showed the increase in the temperature of the juice passed through to be from 80° to 195° F. The LeBlanc condenser of the effect maintained a vacuum of 24·8 in. using 604,128 lbs. of cooling water per hour with a pressure of 12·7 lbs. in the discharge pipe. In the pan condenser, which was of the same type, 761,854 lbs. of water per hour were used with a pressure of 10·6 lbs., maintaining a vacuum of 26·4 in. The following are the data obtained in the boiler plant and steam turbine tests:—

TABLE 1.

	General.	
1.	Date of test	Jan 19th, 1916
2.	Duration of test, hours	14·35
3.	Average tons ground per 24 hours	873 6
4.	Extraction, per cent.	81·6
5.	Moisture in bagasse, approximate per cent.	49·4
6.	Temperature feed water, degrees F.	195·3
7.	Temperature flue gases, degrees F.	510
8.	Atmospheric pressure, lbs. per sq. in.	14·70
9.	Reading at switchboard, average kilowatts	577
	Turbine Boilers.	
10.	Steam pressure of turbine boilers, lbs.	133·6
11.	Degrees superheat of steam from turbine boilers, degrees F.	87·8
12.	Steam pressure at turbine, lbs.	125·2
13.	Back pressure on turbines, lbs.	3·56
14.	Water fed to turbine boilers per hour, lbs.	22,248
15.	Steam per kilowatt hour, lbs.	38·55
16.	Steam per H.P. hour, at switchboard, lbs	28·76
17.	Boiler H.P. developed by turbine boilers	717·78
	House Boilers.	
18.	Steam pressure house boilers, lbs.	110·9
19.	Water fed to house boilers per hour, lbs.	13,000
20.	Quality of steam	99
21.	Factor of evaporation	1·049
22.	Water evaporated from and at 212° F. per hour, lbs.	13,620
23.	Boiler H.P. developed by house boilers	397·5
24.	Total boiler H.P. of house	1,115·3
25.	B H.P. per ton of cane per 24 hours	1·277
26.	Exhaust steam from turbines, per cent. weight of cane	30·52
27.	Direct steam for house, per cent. on weight of cane	14·85
28.	Total steam, per cent. on weight of cane	45·37

---

[1] Abridged from the Report of the Proceedings of the Fourth Annual Convention of Sugar Mill Engineers, Honolulu, October, 1916.

The following figures show the power measurements of most of the motors of the factory:—

TABLE 2.

	E H P developed by motor.	Rated H.P of motor.
1. Crusher and 1st and 2nd mills (32 tons per hour)	104·0	250
2. Crusher and 1st and 2nd mills (42·6 tons per hour)	191·5	250
Centrifugals (both sets)	83·2	250
3. Crusher and 1st and 2nd mills (53·4 tons per hour	210·0	250
Westinghouse LeBlanc condenser for pans	87·4	80·0
4. 3rd and 4th mill (29 4 tons per hour)	162·2	200
5. 3rd and 4th mill (36·5 tons per hour)	186·2	200
6. 3rd and 4th mill (38·25 tons per hour)	194·0	250
7. Westinghouse LeBlanc condenser for quadruples	83·2	80·0
8. Crystallizers	..	20·0
9. Bagasse carrier to storage and boilers	..	20·00
10. Cane carrier	..	15·0
11. Electric hoist for unloading wagons	..	15·0
12. Sugar elevator and screw conveyor	6·2	10·0
13. "Cush-cush" elevator	2·0	10·0
14. Bagasse drag	2·8	7·5
15. Bagasse hoppers	0·6	3·0
16. Filter-press mud drag, washing machine, and dryer, only the drag loaded 4.1	2·8	10
17. Carrier and washing machine, latter empty	3·1	10
18. Carrier and dryer only, latter empty	3·8	10
19. Auxiliary cane carrier	..	3
20. Hydraulic cane dump pump	3	..
21. Juice heater pump	20·6	25·0
21. "Rotrex," vacuum pump	10·7	10·0
23. Syrup pump	3·9	5·0
24. Sweet water pump, 2nd body, also for condensation from vapour juice-heaters	1·6	5
25. Quadruple juice feed pump	2·2	3·0
26. Triplex mud pump	2·4	3·0
27. Molasses pump for 1st centrifugals	1·0	3·0
Molasses pump, 2nd centrifugals	..	3·0
28. Mill journal and maceration water pump	1·2	2·0
29. Mill well pump, 1st stage	6·4	7·5
30. ,, ,, ,, 2nd ,,	7·4	7·5
Magma pump	..	10·0
31. Lime mixers and lime pumps	2·6	3·0
32. Centrifugal feed water pump, 5th stage	..	50·0
33. Pump from boiler recipient to house hot water tank	..	10·0
34. Centrifugal pump water supply (at spring)	..	20·0

Particular attention is directed to items 25 to 28 of Table 1, and it would be of interest to compare these figures with results obtained in Hawaiian factories, both with and without electrical equipment. These factors, of course, are influenced to a large extent by the size of the equipment, the insulation of the steam piping, the quality of the cane ground, etc., but it is an undisputed fact that radiation losses in steam piping are reduced to a minimum by replacing individual steam-driven units by electric motors.

Item 16 of Table 1 gives the steam consumption per H.P. hour at the switchboard of 28·76 lbs., which is about what could be expected of a Corliss engine driving the mill rollers. One may therefore ask what the advantage is of using electric drive on the rollers; and why a turbine of sufficient capacity for operating the balance of the mill machinery should not be installed, while operating the roller equipment by steam drive.

In order to answer these questions, it is necessary to refer to Table 2, where it is seen that the total connected H.P. is 910·5, of which 450 H.P. is installed for operating the rollers. The actual measured power consumption of the motors is 637 H.P., of which 380 H.P. is consumed by the rollers, leaving a balance of 257 H.P. for auxiliary drive. To this must be added some proportion of 166 H.P. installed, on which no power measurements were taken. Assuming the load factor of this unmeasured power to be 60 per cent., the actual power to be added would be 100 H.P., bringing up the total power consumption of auxiliaries to 357 H.P. Therefore a 300-kilowatt turbine unit would have to be installed to furnish power for operating electric drive in the factory exclusive of the rollers, and its steam consumption would be at least 30 per cent. higher than that of the 800-kilowatt unit actually installed, The total steam consumption of the mill engines at 30 lbs. per H.P. hour would be 11,400 lbs. per hour, and for the turbine, 15,708 lbs. per hour, a total of 27,108 lbs. per hour. The actual quantity of water evaporated by the turbines and house boilers is 35,248 lbs. per hour, which is 8140 lbs. in excess of the exhaust from the mill engines and the 300-kilowatt turbine. This means that this excess steam actually required by the boiling house would have to be made up by the house boilers.

The first conclusion drawn, therefore, in answer to the questions raised above is that, according to the steam requirements of this particular factory, a saving would have been effected by installing Corliss engines for the rollers and electrifying the balance of the mill. This saving is shown, not in any decreased operating expense, but rather in the reduced original investment. Thus, the difference in cost between two 800 and two 300-kilowatt turbines (allowing a spare in each case) would amount to $14,000; while the cost of two 250 H.P. Corliss engines may be placed at $9000, and that of two 250 H.P. electric motors at $5000. There are of course other factors to be considered in favour of the complete electrification, as reduced maintenance, cost of installation, space, and attendance.

But let us examine what the steam conditions would have been had the factory been steam-driven throughout. Assuming the average steam consumption for the auxiliaries as not less than 75 lbs. per H.P. hour, their total steam consumption would be: 357 × 75 = 26,755 lbs, per hour, and the total steam consumption for the factory would be this *plus* 11,400 = 38,175 lbs. per hour, or 2927 lbs. per hour in excess of actual steam requirements, as given in the test, equivalent to 8·3 per cent. excess of steam. In addition, there is the expensive steam piping required, with its consequent heat losses in radiation and leakage, so that electric drive should show a saving in heat economy of at least 15 per cent. If in the factory under consideration it was necessary to burn extra fuel in order to generate the steam necessary for the boiler house, the matter of heat economy in its case was of prime importance.

One effect of the shortage of sugar is reflected in the complaints that mothers are frequently unable to get sugar wherewith to feed their infants. Efforts are being made at infant welfare centres and by certain other agencies to remedy the deficiency, as it is realized that sugar is an important article of diet in infant feeding.

During June the Clyde sugar market had no foreign refined, neither white Java nor American granulated, but the timely arrival of some raw sugars kept the refineries going. A few small sales of low cane sugars were made, Manilas for example fetching 41s. 6d. to 42s. 6d. per cwt., duty paid ex warehouse. Supply remained unequal to the demand, and the output of the refineries was cleared daily at full limits.

Examination Papers for the Registration of Chemists in Mauritius, 1916.

Agricultural Chemistry.

1. Describe the chemical actions which take place when an organic substance is boiled for some time with strong sulphuric acid. How is this process used for estimating nitrogen? What modification is made to the process when a nitrate is present? (12)

2. What is the composition of guano phosphate? In what respect does its composition differ from the fresh excrements of birds and what is the explanation of the same? (8)

3. A special cane manure is found on analysis to contain: Ammoniacal nitrogen, 8·20 per cent.; nitric nitrogen, 4·65 per cent.; phosphoric acid, 8·00 per cent.; potash, 5·00 per cent. What is your opinion of (1) its suitability for application to the virgin lands of Sans Souci Estate, (2) its cost.[1] Give the reasons on which you found your opinion. (16)

4. Describe and explain the chemistry of the processes employed for estimating lactose in milk. (10)

5. What is the relative food value of proteids, carbohydrates, and fats for animal nutrition? To what purposes are these substances put in the animal body? (12)

6. Describe in detail the methods used in this colony for the physical analysis of a soil. Discuss its advantages and limitations. (12)

7. Describe the preparation of precipitated phosphate. Why should superphosphate not be used on (1) land containing much humus; (2) land deficient in lime; (3) land containing much iron? (12)

8. Write a short essay on "stereo-isomerism." (18)

Bio-Chemistry.

1. Describe the life-history of the yeast plant. What explanations would you offer for the difference between Bourbon and Mauritius rums? The former is generally the more in favour. (15)

2. What rôle does moisture play in the keeping quality of sugar? (10)

3. What do you know about the chemical changes that take place in the decay of humus? (15)

4. Describe in detail what takes place when a soil is heated, and illustrate your answer by reference to the practical uses to which the practice of heating soils is put in horticulture and agriculture. (10)

5. Write what you know about the digestion and absorption of proteids in the animal body. (10)

6. Describe the process of photo-synthesis and state how carbohydrates are diffused throughout the plant organism. (15)

7. What do you know of the nitrogen content of rain water, and how would you determine the amount of nitrogen in a rain water in the form of nitrates? (10)

8. Write a short essay on the "nitrogen cycle." (15)

Sugar-house Chemistry.

1. Indicate the best method by which you would practise rational maceration using a 9-roller mill with crusher. Which is the best place to apply the water, and name the appliance or appliances for the distribution of this water? (20)

---

[1] The current market value of the several constituents was given.

2. Describe briefly the method, generally practised in Mauritius, of manufacturing sugar as far as massecuite, and state how it differs from that followed in Java. (20)

3. Describe and illustrate with a sketch the course of the juice and of the steam in an evaporating apparatus. Say how the condensed waters and the incondensible gases are evacuated, the apparatus chosen being a quadruple effect with two juice re-heaters, one at the first and the other at the last vessel, and both placed in the track of the steam. (20)

4. Indicate the general scheme of using steam in a cane sugar factory, taking as the type a factory using only the exhaust vapour of its engines for evaporating and boiling. (15)

5. Show and illustrate by means of a sketch the mounting of a marine boiler, and also describe a step grate furnace and a grate bar furnace. (15)

6. Which kinds of water are employed in the production of steam in a factory? In what circumstances would you avoid the use of: (*a*) natural water; and (*b*) condensed water? (10)

Sugar-house Control.

1. Describe in detail the method of determining sucrose and glucose in a sample of molasses. (25)

2. What do you know of the action of sulphur dioxide upon cane juice? (25)

3. Being given a virgin massecuite of 86° purity and a poor syrup from centrifugals of 62°, and assuming that one desires to obtain a final mixture of these two products of 80°, what quantity of syrups is it necessary to introduce into the vacuum pan to arrive at this result? (25)

4. Fill in the blanks of the Mutual Control Bulletin provided you. (25)

Practical Chemistry.

1. Estimate the quantity of phosphates in the strong acid soil solution provided. (25)

2. Estimate the sucrose and glucose in the sample of molasses handed you. (25)

3. Analyse the canes given you. (25)

4. The sample of milk provided is suspected of being adulterated. Make an analysis of it and give your opinion as to its adulteration or purity. (25)

The late Thos. U. Walton.

We regret to record the death on February 1st, of Mr. THOS. U. WALTON, Chief Chemist of the Colonial Sugar Refining Co., Ltd., Sydney, Australia. Born in Greenock in 1852, he was educated at Greenock Academy and Glasgow University, where he took the B.Sc. degree. After spending some years in Greenock refineries, he went to Sydney to take up the position which he held until his death. There is no doubt that the present remarkable state of technical efficiency of the factories and refineries of the Colonial Sugar Refining Co. is due in a very large measure to Mr. WALTON's ability and zeal. He had been Secretary of the Sydney section of the Society of Chemical Industry since its inception in 1903.

The revenue of the United Kingdom for the year ending last March included the sum of £18,328,931 derived from the duties on sugar and molasses. This sum is a great advance on the amount obtained in the 12 months ending March 1914, which was no more than £3,328,536.

Progress of the Chemistry of the Carbohydrates during 1916.[1]

By J. C. IRVINE, D.Sc., Ph.D

CARBOHYDRATES.

Recent work on the sugars furnishes a striking instance of the renewal of interest in a group of compounds, the study of which was apparently on the decline. Subsequent to the time when Fischer's synthetical work in this field diminished from its first activity, there succeeded a period which naturally suffered by comparison with the brilliancy of that which preceded it. During this interval, however, much steady and valuable progress was made, which has prepared the way for the present revival and for future advances, which promise to be of great importance.

During the past three or four years, the pages of the various journals bear ample testimony to the fact that research on the simple sugars is now attracting many workers (both old and new), and is showing a distinct tendency to expand. Questions of constitution are still prominent, and, as a necessary result, synthetical work is receiving a new impetus. Speaking generally, the experimental study of sugars may, at the present time, be classified under four heads: (1) investigations on the structure of reducing sugars; (2) the synthesis of partially substituted sugars; (3) the relationship between rotatory power and configuration; (4) syntheses effected by enzyme action. All these developments are affected by the recognition now given to the existence of reducing sugars in forms other than the recognized α- and β-types, and this consideration should be kept strictly in view both in reviewing old observations and in the interpretation of all new results.

Although most of the reducing sugars have been isolated in well-defined, mutarotatory forms which possess, presumably, the γ-oxidic linking, other isomerides may and, in certain cases, do actually exist. Thus, taking glucose as an example, the standard crystalline forms of the sugar (α and β) correspond with the isomeric crystalline methylglucosides. In addition, however, two other methylglucosides have been proved to be present in the so-called "γ-methylglucoside," but so far no crystalline variety of glucose has been isolated other than the above α- and β-forms, either individually or as mixtures. The existence of no fewer than four methylglucosides shows that the parent sugar must react in four forms, in two of which the ring-forming oxygen atom does not occupy the customary γ-position.

Considering the cyclic structures possible in a hexose, it is evident that, as a maximum, there may be five isomeric glucoses in addition to the aldehydic type, each capable of existing in α- and β-forms, and similar considerations may well apply to all reducing sugars. Little systematic progress has been made during the past year in the important problems thus opened out, but a considerable amount of indirect evidence has been obtained which supports the views expressed above. Thus, HUDSON and his co-workers, in the course of their investigations on rotatory power in the sugar group, isolated a second form of galactose penta-acetate,[2] and followed this up by the preparation of a third[3] and a fourth variety.[4] According to accepted views of structure, galactose should only give two non-reducing penta-acetates, but the isolation of four such compounds shows that this sugar must exist in at least four forms, and the satisfaction of having isolated the first series of crystalline derivatives corresponding with the newly recognized type of sugar isomerism thus rests with the American School.

---

[1] Extracted from the Annual Reports of the Chemical Society, London, for 1916. Cf. also *I S.J.*, 1916, 216–219.

[2] C. S. HUDSON and H. O. PARKER, *J Amer. Chem. Soc.*, 1915, 37, 1589.

[3] C. S. HUDSON, *ibid.*, 1591. [4] C. S. HUDSON and J. M. JOHNSON, *ibid.*, 1916, 38, 1223.

Close inspection of some of Fischer's recent work likewise reveals evidence pointing similarly to the idea that we are only at the beginning in unravelling the complexity of even the simplest sugar molecules. Although Fischer himself is meanwhile of a different opinion, good reasons exist for the belief that the compound known as glucosemonoacetone is derived from the hypothetical "γ-glucose," and in such case it would follow that the trisubstituted sugars obtained from glucosemonoacetone would also belong to the γ-type. Trimethyl glucose was the first representative of this class, and the corresponding tribenzoyl glucose has now been isolated as the result of similar processes. The new sugar is a viscous oil and displays well-marked additive properties, these features being characteristic of members of the γ-glucose series, so far as these compounds have been examined. In the course of the research now under discussion, a description is given of an improved method of preparing glucosemonoacetone by cautious half-hydrolysis of glucosediacetone, but it may be remarked that the details of precisely the same method were published more than a year ago,[1] and were mentioned in last year's report.[2]

Considerable interest is attached to the partial acylation of polyhydric alcohols and sugars, which is now engaging the attention of Fischer.[3] These compounds have been prepared by the general methods described by Irvine and Scott in the case of reducing sugars, and by Irvine and Paterson for polyhydric alcohols, and as few new examples have recently been added to the list of partially substituted glucoses, most of the results are thus described elsewhere.

Although the generalizations established by Hudson regarding the relationship between rotatory power and constitution in the sugar group were first applied to simple glucosides, it has recently been shown in numerous cases that the principle extends to acetylated aldoses of different types, and even to the monobasic acids allied to the sugars.[4] A further important observation is that the rule holds approximately in the case of acetylated derivatives of amino-sugars, thus indicating that the nature of the groups in the sugar chain has a relatively small effect on the rotation of the terminal asymmetric system.[5] One result of this line of work has been the preparation of a large number of acetylated sugars, and the introduction of many improvements in the methods of preparing and purifying these compounds.[6] The results obtained in the optical study of these compounds confirm Hudson's views, and in cases where experimental values are not in agreement with the rule, it is probable that this is due to the derivatives under examination being related to entirely different forms of the parent sugar. Incidentally, in the course of this work a number of important observations have been made. Thus, starting from tetra-acetyl fructose, for which a simple method of preparation is described, a new form of fructose penta-acetate is obtained by the action of acetic anhydride containing zinc chloride. It is a curious fact that the two isomeric fructose penta-acetates so far known are not incontrovertible by the action of zinc chloride, and it is quite possible that they are derived from different types of fructose. The chemistry of fructose will no doubt be considerably expanded by the use of tetra-acetyl fructose, and the reagent has already been turned to good account in the preparation of a crystalline variety of methylfructoside.[1] There is little doubt that fructose shows a pronounced tendency to exist in reactive forms similar to "γ-glucose," in which the ring-forming oxygen is connected to a carbon atom other than that in the γ-position. Thus it has been shown[2] that the syrup originally isolated by **Fischer** by the condensation of fructose with methyl alcohol contains two distinct methylfructosides of different type. One of these compounds resembles the α- or β-methylglucosides, and fails to react with acetone, but the other enters into ready condensation with the ketone, and is, in addition, characterized by the ease with which it reduces permanganate. The existence of these distant fructosides clearly indicates that the parent sugar can react in at least four forms, the most probable structures of which are shown below :—

---

[1] J. C. Irvine and J L. A Macdonald, *J Chem Soc*, *T*, 1915, **107**, 1701, A, I, 17

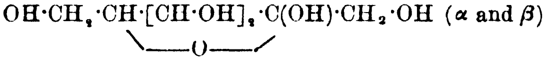
[2] *I.S J*, 1916, 216

[3] Part II. E. Fischer and C. Rund, *Ber*, 1916, **49**, 584 Part III, E. Fischer and M. Bergmann, *loc cit.*

[4] P. A. Levene, *J. Biol. Chem.*, 1915, **23**, 145. See also P A. Levene and G. M Meyer, *ibid.*, **26**, 355.

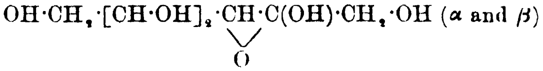
[5] C. S. Hudson and J. K. Dale, *J Amer. Chem. Soc*, 1916, **38**, 1431.

[6] See also C. S Hudson and D. H Brauns, *ibid*, 1915, **37**, 2736; C. S. Hudson and J M Johnson, *ibid.*, 1915, **37**, 2748



$OH\cdot CH_2\cdot CH\cdot[CH\cdot OH]_2\cdot C(OH)\cdot CH_2\cdot OH$ (α and β)

Fructose of normal type.



$OH\cdot CH_2\cdot[CH\cdot OH]_2\cdot CH\cdot C(OH)\cdot CH_2\cdot OH$ (α and β)

Fructose of the ethylene-oxide type

Additional evidence pointing to the idea that fructose shows a ready tendency to react in forms other than the standard α and β-varieties is afforded by the somewhat complicated results recently obtained in a study of the conductivity changes shown during the mutarotation of fructose dissolved in boric acid.[3]

Brief reference was made in last year's Report[4] to a new and convenient method devised by **Weerman** for degrading sugars to lower members. Fuller details of the working methods employed, and their range of application, are now available, and a few characteristic cases in which the method has been used successfully are noted below.

1. *d*-Glucose → *d*-arabinose.
2. *d*-Galactose → *d*-lyxose.
3. *l*-Mannose → *l*-arabinose.
4. *l*-Arabinose → *l*-erythrose.

In the experience of the writer of this Report, the reactions involved[5] proceed with the utmost smoothness, and constitute a great improvement on the methods hitherto in use.

Although amino-sugars are few in number, they never lose in interest. The complex problems connected with the constitution of these compounds are now being studied by **Levene**, who is engaged on a systematic investigation which has as its object the determination of the configuration possessed by glucosamine The work has not proceeded far enough for definite conclusions to be drawn, but has resulted in a considerable extension of our knowledge of the amic acids related to the amino-aldoses.[6] [7] Incidentally, this work has confirmed a point of fundamental importance to this section of sugar chemistry, in that the suggestion already made that compounds of the type of glucosimine are in reality aminoglucosides, has been confirmed, and has been shown to be equally applicable to imines of the pentose series.[1] Among other results recently to hand on this subject may be noted the fact that chondrosamine and a lyxohexosamine prepared synthetically yield the same osazone, and, further, that the corresponding amino-acids give the same anhydromucic acid on oxidation.[2] The difficulties which usually attend the allocation of the amino-group in these compounds may in some measure be removed by taking advantage of generalizations regarding the rotations of epimeric hexosamic acids, and the further extension of Levene's work will be closely followed.[3]

---

[1] C. S Hudson and D H Brauns, *J Amer Chem. Soc*, 1916, **38** 1216.

[2] J C Irvine and G. Robertson, *J Chem Soc.*, *T*, 1916, **109**, 1305

[3] J Böeseken, A. J. Kerstjens, and C. E Klamer, *Proc. K. Akad Wetensch*, *Amsterdam*, 1916, **18**, 1654, *J. Chem Soc*, *A*, i, 596

[4] *Loc. cit*

[5] R. A. Weerman, "Over de inwerking van natrium hypochloriet op amiden van onverzadigde zuren en oxyzuren," *Dissertation Delft*, 1916.

[6] P. A. Levene, *J. Biol Chem*, 1916, **24**, 55, *J. Chem Soc*, *A.*, i, 203.

[7] P. A. Levene and F. B La Forge, *ibid.*, 1915, **22**, 331; *J. Chem. Soc*, *A*, 1915, i, 944

As indicated in last year's Report, work on the synthesis of glucosides by means of the action of enzymes has recently shown a distinct falling off, but the new literature on this subject is still fairly extensive. Among the recent results of importance may be mentioned the synthesis of a galactobiose[4] by the auto-condensation of galactose under the influence of emulsin. Considering the fact that we are still far from a complete understanding of the linkings present in even the simplest disaccharides, it is unfortunate that the new sugar, which is apparently different from the galactobiose already described, has only so far been obtained as a syrup, and thus its detailed examination has naturally been restricted.

Although exact studies on the selective hydrolysis of either glucosides or compound sugars ought to be conducted with enzymes which have been purified from closely related forms, it would appear that drastic purification is unnecessary in the case of syntheses effected by enzymes.[5] It must be admitted that the synthetical action of enzymes has in the past few years led to many notable achievements, particularly in cases to which ordinary processes are inapplicable, but despite this success the synthesis of sucrose still remains unaccomplished,[6] and, considering recent views as to the structure of sucrose, this negative result is not surprising.

DISACCHARIDES.

The hydrolytic process referred to above, in which raffinose is degraded to melibiose and fructose, has been utilized for the preparation of the disaccharide on a large scale. The working details show that the process proceeds smoothly, and thus another example[7] has been added to the already lengthy list of excellent preparations in the sugar group, which we owe to the American chemists.

From the theoretical point of view, two important contributions have been made during the year to the chemistry of disaccharides. The first refers to the identification of numerical relationships between the molecular rotation of a disaccharide of the sucrose group and those of the α- and β-forms of the aldose produced on hydrolysis. The interesting, but somewhat intricate, generalization thus established can only be properly appreciated by reference to the original paper,[8] and, no doubt, its future development will be awaited with much interest.

As a result of observations described in a recent paper,[9] current views on the constitution of sucrose are largely overthrown. The fact that invert sugar consists of an equimolecular mixture of glucose and fructose has been too readily accepted as evidence that the forms of the sugars thus isolated are of necessity the forms in which they are combined in the disaccharide. On the contrary, direct hydrolysis of sucrose affords little or no evidence as to the constitution of the constituent hexoses, but a rigid proof has now been supplied by a study of the hydrolysis of fully methylated sucrose. Octamethyl sucrose has now been obtained in the pure state in considerable quantity, and gives, when treated with dilute acid, tetramethyl glucose and tetramethyl fructose, in which the linkings are of necessity preserved exactly as in the parent disaccharide. The methylated aldose actually isolated proved to be the characteristic tetramethyl glucose of the butylene-oxide type, thereby confirming a previous result, but, on the other hand, the ketose displayed a rotatory power and reaction towards permanganate which at once stamped the compound as being allied in structure to "γ-glucose." A new formula for sucrose is thus indicated, which accounts not only for the extreme ease with which the disaccharide is hydrolysed, but also for previous failure to effect its synthesis. This provisional formula shows a butylene-oxidic aldose coupled to an ethylene-oxidic ketose through their reducing groups:—

---

[1] P. A. LEVENE, *ibid.*, 1916, **24**, 59, *J. Chem. Soc.*, *A*, i, 201.

[2] P. A. LEVENE, *J. Biol. Chem*, 1916, **26**, 143; *J. Chem. Soc.*, *A.*, i, 712.

[3] *Ibid.*, 357; *J. Chem. Soc*, *A*, ii, 546

[4] E. BOURQUELOT and A. AUBREY, *Compt. rend.*, 1916, **163**, 60; *J. Chem. Soc*, *A*,, i, 596.

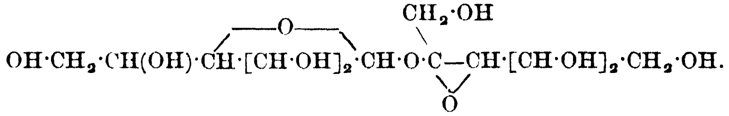
[5] *Ibid.*, 1915, **161**, 463, *J. Chem. Soc.*, *A.*, 1915, i, 1076.

[6] W. LÖB, *Biochem. Zeitsch.*, 1916. **72**, 392; *J. Chem. Soc.*, *A.*, i, 296.

[7] *Ibid.*, 2734; *J. Chem. Soc*, *A.*, i, 120.

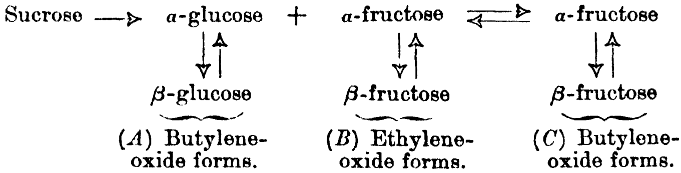
[8] C. S. HUDSON, *ibid*,, 1916, **38**, 1566, *J. Chem. Soc.*, *A.*, i, 630. See also S. C. HUDSON and R. SAYRE, *ibid.*, 1867; *J. Chem. Soc*, *A.*, i. 711.

[9] W. N. HAWORTH and J. LAW, *J. Chem. Soc.*, *T.*, **1916**, **109**, 1314.



$$\mathrm{OH\cdot CH_2\cdot CH(OH)\cdot \overbrace{CH\cdot[CH\cdot OH]_2\cdot CH}^{O}\cdot O\cdot \overset{CH_2\cdot OH}{C}\underbrace{—CH}_{O}\cdot[CH\cdot OH]_2\cdot CH_2\cdot OH.}$$

Accepting this view, the hydrolysis of sucrose became an exceedingly complex change, best represented by a diagrammatic scheme, which shows how the sugars liberated on hydrolysis not only undergo mutarotation, but, in the case of fructose at least, change from one type to another:—


Sucrose
α-glucose
+
α-fructose
α-fructose
β-glucose
β-fructose
β-fructose
(A) Butylene-oxide forms.
(B) Ethylene-oxide forms.
(C) Butylene-oxide forms.

The final products consist essentially of the equilibrium mixtures (A) and (C) together, probably, with a small proportion of (B).

The importance of the advance which has been made in the study of the most interesting of all sugars, and the new lines of work thus opened out, will be fully realised.

POLYSACCHARIDES.

It is probably only right that much of the work done in this group remains physical rather than chemical in character, for there is much still to be learned as to the effect of surface conditions in modifying chemical changes when dealing with complexes of high molecular weight and sparing solubility. This is borne out in much of the recent work on the chemistry of starch, where, to take a case in point, the formation of the so-called crystalline starch[1] is in all probability due to the precipitation of the colloid by the action of traces of mineral salts.[2] The influence of surface conditions is probably also responsible for the distinct difference which has been noticed in the relative ease with which cellulose and starch may be acetylated, and in the effects which different catalysts have on the reaction.[1]

---

[1] M. W. BEYERINCK, *Proc K. Akad Wetensch Amsterdam*, 1915, **18**, 305, *J Chem Soc*, *A*, 1915, i, 940.

[2] W. HARRISON, *J. Soc. Dyers*, 1916, **32**, 40; *J. Chem. Soc., A.*, i, 251.

The examination of starch by purely chemical methods has also yielded interesting results, and at least one element of confusion has been removed in the course of two recent investigations[2] dealing with the phosphorous-containing constituent. The idea seems to have prevailed that the starch complex contains an unstable fragment, in which phosphoric acid is combined, and that this is the first portion of the molecule to be removed on hydrolysis. Such is not the case, as during the degradation of starch with 10 per cent. hydrochloric acid the unhydrolysed residue contains most of the combined phosphorous. In fact, there are good reasons for the belief that a definite compound will in time be isolated which would represent the carbohydrate phosphate originally present in the starch complex. The results of the paper now under review are not inconsistent with Samec's observation that the removal of the phosphorous constituent is the initial action when starch is decomposed with alkalis.

Naturally enough, most recent investigations on cellulose have had a direct technical bearing, and there does not appear to be any necessity to refer to them, as no points of general theoretical importance have been noted.

The Japanese Sugar Industry.

(British Embassy Report.)

Owing to the war, the issue of British Consular Reports has been suspended for some time; but the following particulars regarding the Japanese and Formosan sugar industry have lately been supplied to the Board of Trade by the Assistant Commercial Attaché at Tokyo, Mr. G. P. Paton, and will be found of interest.

A considerable development has taken place in the sugar industry of Japan—in which must be included the Colony of Formosa, for it is there that the development has been most striking.

In Japan itself, however, as a result of Government assistance, there has been an increase in sugar production, the average annual output for the past few years having been 1,250,000 piculs. With sufficient protection and State aid the Japanese output may eventually rise to 2,000,000 piculs. Of the present quantity, 80 per cent. is black sugar and 20 per cent. is a very low grade brown sugar, but the authorities are taking steps to secure the production of centrifugal sugar.

The chief part played by Japan proper in the sugar industry is in refining. The first refinery was established in 1896, and, according to a reliable source of information, there are now eight establishments with a capacity of 1,300 tons per day.

Exports from Japan consist almost wholly of refined sugar, the average annual export of which in 1912, 1913 and 1914 amounted to 1,300,000 piculs, valued at 12,000,000 yen. The principal market for Japanese refined sugar is China, where it is said to be gradually supplanting Hong-Kong sugar.

The development of the sugar industry in Formosa was taken in hand by the Government in 1902, and regulations were promulgated for its encouragement. As a result of generous Government assistance, which took the form of the employment of experts, the establishment of an experiment station, subsidies, and the loan of machinery, the production of sugar in Formosa increased rapidly. Production prior to 1902 had never reached 1,000,000 piculs ; but by 1906 it had risen to 1,280,000 piculs and by 1910 to 3,775,000 piculs. In 1916 all records were broken, the estimated output being 6,200,000 piculs (366,100 tons) of centrifugal sugar and 700,000 piculs (41,335 tons) of brown sugar.

---

[1] J. BÖESELEN, J. C, VAN DEN BERG and A H. KERSTJENS, *Rec. trav. chim.*, 1916, **35**, 320; *J. Chem. Soc*, *A.*, i, 308.

[2] M. SAMEC, *Koll. Chem. Beihefte*, 1916, **3**, 33; *J. Chem. Soc.*, *A.*, i, 308. J. H. NORTHROP and J. M. NELSON, *J. Amer. Chem. Soc.*, 1916, **38**, 472; *J. Chem. Soc.*, *A.*, i, 373.

The first charter for the erection of a modern sugar mill in Formosa was granted in 1901, and there are at present 14 companies owning 37 crushing factories, with an aggregate crushing capacity of 27,240 tons per day of 24 hours. The total paid-up capital of these companies amounts to 56,175,000 yen.

Although the export of sugar from the Island to foreign countries was at first considered to be a matter of secondary importance, attention is now being turned to the export trade, the supply having overtaken the home demand.[1]

Publications Received.[2]

***Handleiding voor Tropische Witsuikerfabricatie. [Handbook of Tropical White Sugar Manufacture.]** W. H. Th. Harloff and H. Schmidt. Third revised and enlarged Edition. (J. H. de Bussy, Amsterdam.) 1917.

Messrs. Harloff and Schmidt's "Handleiding" was first introduced to English-speaking sugar technologists through the medium of a translation, which was published nearly four years ago.[3] This volume met with a welcome reception, and those perusing it must have been impressed by the very thorough nature of the authors' studies of the processes of sulphitation and carbonatation in general and of the acid thin-juice process in particular. Since writing the second Dutch edition from which the English translation was made, several rather promising new methods have been examined, thus necessitating the appearance of a third edition. These new methods comprise so-called "hot sulphitation," BACH's thick-juice sulphitation ; DE HAAN's carbonatation, and "Norit" decolorization. Some minor additions also are included, such as a short description of the operation of the lime-kiln and the Kelly filter-press ; while the volume is now enriched by some excellent drawings and photographs of modern sugar-house plant. "Schema's," or charts illustrating in a clear manner the successive steps of important processes, are also a new feature of the book, these concerning : single and double carbonatation, cold and hot sulphitation, method of boiling to two grades and molasses, method of boiling to one high grade and molasses, and lastly the operation of refining in the raw factory by means of "Norit."

In discussing sulphitation, it is pointed out that in following the usual cold procedure, that is, to lime and sulphite at the prevailing temperature and afterwards heat to boiling point, much trouble is experienced by the deposition of calcium sulphite (as well as some sulphate) in the juice-heaters. Mr. HARLOFF has investigated the conditions of this irregularity,[4] and has found that the solubility of the calcium sulphite in such juice diminishes as the temperature rises, the minimum point being reached about 70°C. (158°F.) He has therefore recommended that the raw juice should preliminarily be heated to about 70°C., and limed and sulphited at that temperature, in this way avoiding the inconvenience and delay consequent upon the incrustation of the tubes of the pre-heater apparatus. This is his "hot sulphitation" method, and it will be remembered that in the English edition a hint was given of its probable success. Factory tests have now shown that heating to a higher temperature than 70°C., say 85°C., has no useful result; but may, on the other hand, act deleteriously on the unlimed juice.

---

[1] A translation of the Regulations for the Control of Sugar Mills in Japan, and of the Regulations for the encouragement of the Sugar Industry in Formosa, together with certain additional information respecting the sugar industry, may be consulted by British firms interested at the Department of Commercial Intelligence, 73, Basinghall Street, London, E.C 2

[2] Books and other Publications marked with an asterisk (*) can be ordered if desired through NORMAN RODGER, 2, St. Dunstan's Hill, London, E C. 3, but in that event the order should be placed with him direct and not through a bookseller. Those not so in indicated should preferably be ordered from the source of publication, especially pamphlets to which no price is attached, as these are in many instances gratis. Postage as a rule is extra.

[3] "Plantation White Sugar Manufacture" W. H. Th. Harloff and H Schmidt, translated by James P. Ogilvie, F.C S. (Norman Rodger, London). 1913. Price 7s. 6d. net, foreign postage 4d.

[4] *Archief*, 1912, 999, 1005, 1008 ; 1913, 492 ; and 1916, 1647

Bach's thick-juice sulphitation[1] and de Haan's carbonatation methods[2] are known to readers of this *Journal*, though fuller general details are here given of them than in previous publications. Refining raw sugar by means of "Norit" decolorizing carbon is fairly exhaustively described, but practical results regarding its economical use on the large scale (much as these are to be desired) are lacking. It is mentioned that the loss of carbon during the incineration stage of revivification shows as 1 per cent., though in fact this may probably be higher, owing to the increase of the weight by carbonized organic substances as bagasse and other suspended particles. The inventors of the "Norit" process[3] appear most generally to counsel the application of the carbon to the thin and thick-juices, but we notice that Messrs. HARLOFF and SCHMIDT point out that it would seem to be more rational, instead of expending the power on a maximum decolorization of the syrups (in which all the molasses constituents are contained) rather to apply it, as has already been done successfully in the beet sugar industry, to the "affined" or water-washed raw sugars after remelting them to 60° Brix and acidifying with phosphoric acid. Four to five per cent. of the carbon is used, and the temperature should be at least 90°C. (though actual boiling seems unnecessary). After treatment and filtration the clear liquor is concentrated to give first and second refined sugars, while the "molasses" is returned to the raw sugar department, there to be boiled in with the syrups.

*Report of the Government Chemist upon the Work of the Government Laboratory for the Year ending March 31st, 1916.

(Wyman and Sons, Ltd., 29, Breams Buildings, Fetter Lane, E.C.) Price: 2½d. 1916.

Sugar, Glucose, Saccharin.—The number of samples of sugar and articles containing it examined for the assessment of duty of drawback during the year under review was 24,682. Of these, 21 samples consisted of beets, sugar, and molasses from the Cantley factory. Honey, although not liable to duty when genuine, is frequently adulterated with invert sugar, and of 68 samples examined, 5 afforded evidence of the presence of added invert sugar, being accordingly charged with duty. In connexion with the assessment of the excise duty on glucose, 321 samples were taken for examination during the course of manufacture, while 181 samples were examined for the drawback repayable on exportation, together with 439 samples of glucose used in syrups made at sugar refineries In searching for saccharin in all preparations in which there is any probability of its occurrence, 309 samples of condiments, dentifrices, and medical preparations were examined, the coal-tar product being found in 38 of these. *Hydrometers, Saccharometers, Thermometers, and Graduated Vessels.*—These apparatus are tested at the Laboratory as to their accuracy before being issued to the Officers of Customs and Excise, and 3669 such tests were made. From time to time the standard thermometers kept at the Government Laboratory are examined to ascertain whether any change has occurred in their constants. It is usual at the same time to make a similar examination of the standard thermometers at the National Physical Laboratory, so that instruments examined there for the public may be in exact accord with the hydrometers used officially in the Customs and the Excise Department. Eight official standard hydrometers and seven standards used at the National Physical Laboratory were tested during the year.

Bulletin No. 2: Handleiding ten Deinste der Molencontrôle. [Handbook of Milling Control.]

(Proefstation voor de Java-Suikerindustrie, Technische Afdeeling, Pekalongan, Java.) January, 1917.

This is a reprint of a publication, previously noticed,[4] dealing with the methods of Mutual Control prescribed in Java for the sugar factories of that

---

[1] *I.S.J.*, 1915, 48

[2] *I.S.J*, 1914, 131, 438.

[3] *I.S.J.*, 1912, 720; 1913, 248; 1913, 404. 1914, 566, 1915, 70; 1915, 129, 1916, 517.

[4] *I.S.J.*, 1916, 570.

Colony. Very full directions are given regarding weighing and measuring, the analyses that must daily be carried out, and the compilation of the results obtained for the daily and 15-daily reports.

***Bayley's Chemists' Pocket Book.** Edited by Robert Ensoll, F.C.S., Assistant Chemist, British Dyes, Ltd. 8th edition; foolscap 8vo.; xv + 425 pages. (E. & F. N. Spon, Ltd., 57, Haymarket, London, W.) 1917. Price: 7s. 6d.; postage abroad, 3d.

Bayley's "Pocket Book," which is before us in its 8th edition, is too well-known to require any description. Instead, however, of the oblong 32mo. form in which it has hitherto been published, it now appears in the shape of an 8vo. hand-book, and it is clear that the different size of page has proved much more convenient for the printing of the tables than the narrow depth formerly used. This alteration of form has enabled the whole of the work to be revised, and while the general subject matter and its arrangement remain the same, that which had become obsolete has been omitted, and many new tables have been added. Most of the old tables have carefully been verified, and the whole of the new matter calculated in duplicate from the latest available data. The result is that the "Pocket Book" is enlarged and brought fully up-to-date. It is an invaluable vade-mecum, and a chemical library could hardly be considered complete without it.

LIST OF PUBLICATIONS FOR SALE BY THE SUPERINTENDENT OF DOCUMENTS, WASHINGTON, D.C., U.S.A., RELATING TO PLANTS, AGRICULTURAL CHEMISTRY, SOILS AND FERTILIZERS, FARM MANAGEMENT, INSECTS, FOODS AND COOKING, STANDARDS OF WEIGHTS AND MEASURES, ETC. (Price lists, 44, 8th edition; 40, 8th edition: 46, 10th edition; 68; 41, 7th edition; 11, 8th edition; and 64, 2nd edition, respectively.)

SALTPETRE: ITS ORIGIN AND EXTRACTION IN INDIA. *G. M. Hutchinson, B.A.*, Imperial Agricultural Bacteriologist. Agricultural Research Institute, Pusa, India, Bulletin No. 68, 1916. (Superintendent of Government Printing, India.) Price. 5d.

PHOSPHATE FERTILIZERS FOR HAWAIIAN SOILS AND THEIR AVAILABILITY. *Wm T. McGeorge.* Hawaii Agricultural Experiment Station, Bulletin No, 41. (Superintendent of Documents, Government Printing Officel Washington, D. C., U.S.A.) Price: 15 cents.

STUDIES ON THE DIGESTIBILITY OF THE GRAIN SORGHUMS. *C. F. Langworthy and A. D. Holmes.* United States Department of Agriculture, Bulletin 470. (Superintendent of Documents, Government Printing Office, Washington, D.C., U.S.A.) Price: 15 cents.

UNITED STATES STANDARD TABLES FOR PETROLEUM OILS. Circular of the Bureau of Standards, No. 57. (Superintendent of Documents, Government Printing Office, Washington, D.C., U.S.A.) Price. 15 cents.

PRODUCTION OF SUGAR IN THE UNITED STATES AND FOREIGN COUNTRIES. *Perry Elliott.* U. S. Department of Agriculture, Bulletin No. 473. (Superintendent of Documents, Government Printing Office, Washington, D. C., U.S.A.) Price: 15 cents.

EL CULTIVO DE LA CANA DE AZUCAR EN CUBA. *J. T. Crawley.* Republica de Cuba. Estacion Experimental Agronomica. Boletin No. 35, Febrero, 1917.

Review of Current Technical Literature.[1]

PRESENCE OF INVERTASE IN SUGAR. *H. Pellet. Bulletin de l'Association des Chimistes de Sucrerie de France, 1916, 33, 263-266.*

In the course of special researches relative to the determination of reducing sugars, Mr. MAQUENNE observed an interesting fact, namely, the presence of the enzyme invertase in cane sugars.

If a solution of cane sugar, as for example, Demerara or St. Domingo, be prepared, and some toluene be added to it, the quantity of invert sugar it may contain will be doubled in 24 or 48 hours, owing to the presence of invertase. If, on the other hand, this solution be previously boiled, it will not subsequently undergo any change in the presence of toluene, because the high temperature will have destroyed the invertase, which has its maximum power towards 55°- 57° C., above which it gradually loses its property of transforming sucrose into reducing sugars.

Now if cane juice contains invertase, the enzyme can no longer be present in the syrups, owing to the high temperature and further the action of the lime to which the juices have been submitted. If then the finished cane sugar contains invertase, it must have been formed after evaporation and boiling, and the following is a very probable explanation of how this takes place.

It has been shown that cane sugars may undergo a change after being finished, the extent of which will depend upon the conditions under which they are preserved, namely the temperature, the humidity, and their composition. LEWTON-BRAIN and NOËL DEERR[2] carried out a series of experiments in 1909 for the purpose of determining the bacterial flora of Hawaiian sugars, and thus isolated micro-organisms, the properties and the form of which they described in their bulletin. They thus identified various bacilli, and studied the action of these on sugar solutions, and found that more or less sucrose was transformed, depending upon the organism.

Mr. MAQUENNE in his experiments placed 22 gms. of the Demerara or St. Domingo sugar in a flask, making it up to 110 c.c.; 50 c.c. were placed in another flask, weighed, boiled for six minutes, and the weight adjusted to what it was originally. Another 50 c.c. was placed in another flask, but it was not boiled. To each was added 0·2 grm. of sodium salicylate, which has the property of preventing the formation of any fungus, while leaving the action of the invertase intact. By comparative determinations the amount of reducing sugars per cent. at the commencement and after 24 hours was ascertained.

	Sugar from St. Domingo.			Sugar from Demerara.		
	Immediately after	After 24 hours	After 48 hours	Immediately after	After 24 hours	After 48 hours
Unboiled solution	1·77	2·30	2·97	1·00	1·05	1·10
Solution after being boiled....	1·79	1·79	1·80	1·00	1·06	1·07

It is certain of course that if the solutions had been kept at 50 - 55° C. instead of at the ordinary temperature, the proportion of reducing sugars formed would have been much greater.

Analogous results were observed in the presence of toluene, and all were allowed to stand at the ordinary temperature. The determination of the reducing sugars was made by the method of heating at 63°- 65° C. during 10 minutes, while using also Lehmann's modified process for the estimation of the cuprous oxide precipitated. Thus, it was seen that the St. Domingo sugar contained an appreciable amount of invertase, whereas the Demerara seemed hardly to contain it in any sensible quantity.

---

[1] This Review is copyright, and no part of it may be reproduced without permission.—(Editor, *I.S.J.*)

[2] *Bull. 9, Path., H.S.P.A.*

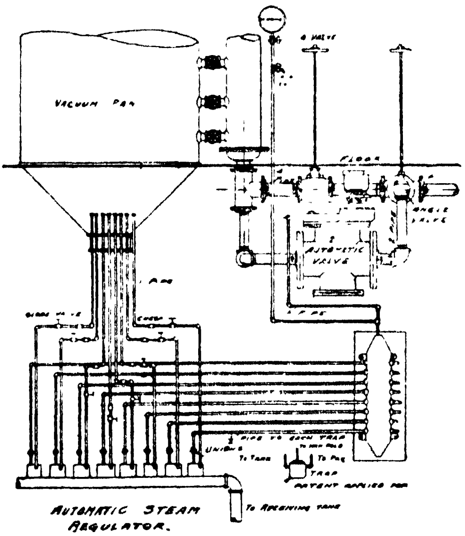
Mr. MAQUENNE points out that it is recognised that during the growth of micro-organisms invertase is formed. Thus, during the development of moulds, *Aspergillus niger*, for example, the enzyme is produced, this organism having actually been used for the preparation of special solutions of invertase. As, therefore, LEWTON-BRAIN and DEERR[1] have established the growth of different bacteria on Hawaiian sugars, it is very natural that invertase should be formed at the same time.

This discovery is very interesting from the point of view of the refinery, since it shows that in order to avoid any chance of the alteration of the sucrose into invert sugar, it is necessary as soon as possible to raise the liquors to a high temperature, and thus destroy the invertase, highly antiseptic reagents being incapable of preventing this deterioration; and further that treatment with lime at the commencement of melting operations is also of much importance, the alkalinity facilitating the destruction of the enzyme even at a temperature not higher than 70°- 80° C.

AUTOMATIC STEAM REGULATOR FOR VACUUM PANS. *Anon. Sugar, 1917, April, 146-147.*

It is claimed of this automatic steam regulator, for which a patent has been applied, that it will enable an efficient utilization of the steam, that the pan may be kept boiling with syrup or magma of any density, that it will permit the steam traps to be worked without trouble, that there will be no leaking around the tail pipes, that there will be no water-hammer, that there will be a uniform heat throughout the pan, and that in short every part of the pan will operate satisfactorily.

It is illustrated in the accompanying sketch. In operating it, the air cock is opened, and boiling proceeded with in the usual way. After boiling for 40 to 50 minutes, the gauge is observed, and while boiling down to grain a pressure of not more than 15 lbs. is maintained. By gradually closing the steam valve in the meantime, one can notice whether the air is all out of the worm and trap. Once the regulator is set, it operates automatically. The air cock may now be closed. As boiling progresses, a more even heat will be noticed, and boiling may be quickened.



AUTOMATIC STEAM REGULATOR.

It is claimed that syrups that are gummy, or generally give trouble for some similar reason, may be evenly and quietly boiled in pans provided with this apparatus. It requires no extra attention, and in addition to the advantages enumerated above, high pressures are prevented on coils and traps. It is advisable when boiling low products to keep the pressure of steam as near 5 lbs. as possible, and never above 15 lbs. If the pan be carried "free and thin," it will be found that one can shut off the steam valve to within ⅛th of a turn. All the steam that can be used is then being taken in, and trying to use more and attain the same pressure at outlet as at inlet, only means waste without any better boiling. The capacity of a steam trap, or the quantity of water that it will discharge, varies of course, with the steam pressure, and under no two different conditions will the same steam trap discharge the same amount of water. But by means of this regulator, a uniform pressure is maintained, and condensation being always the same, naturally the outflow of water is likewise constant.

---

[1] *Loc. cit.*

EXPERIMENTS ON PLANTING CANE STRIPPED BY HAND. *W. E. Cross. Revista Industrial y Agricola de Tucumán, 1916, 7, No. 5, 178-180.*

There has been much discussion in Tucumán about the advantage or otherwise of stripping the cane by hand before planting. It is admitted that such an operation would add considerably to the cost of planting, and it would therefore be inadvisable to follow such a procedure unless a definite advantage in the way of an increased crop were secured. To determine this point the Station has carried out two series of experiments, one in 1911-13, and the other in 1914-16, the results of which are given in this paper.

The methods of planting, cultivation, etc., employed were described by Mr. A. H. ROSENFELD in a short account of the first series of experiments in this connexion, published in the *Revista*.[1] As the methods followed in the second experiment were the same, they will not be gone into here. Suffice it to give the details of planting and harvesting:—

Series I.—Planted 12th July, 1911. Harvested: plant, 17th July, 1912; stubble, 24th June, 1913.

Series II.—Planted 15th August, 1914. Harvested. plant, 15th July, 1915; stubble, 13th July, 1916.

The results of the four harvests are given in the following table:—

Series			Yield, kg of Cane per hectare	Chemical Analysis				Sugar, kg per hectare
				Brix	Sucrose	Glucose	Purity	
I.	Cane stripped by hand	Plant	29,713	15·3	11 6	0·3	75·8	1830
		Stubble	46,753	15 8	12·9	0·2	81·7	3436
	Average		38,233					2633
	Cane planted in the usual way	Plant	29,360	15·6	11·9	0·3	76·3	1870
		Stubble	47,580	14·9	11·4	0·5	76·5	2898
	Average		38,470					2384
II.	Cane stripped by hand	Plant	17,600	12·4	8·5	1·0	68·5	715
		Stubble	22,800	14 2	11·0	1·2	77·5	1356
	Average		20,200					1036
	Cane planted in the usual way	Plant	15,333	12·4	8·5	0·8	68·7	633
		Stubble	22,200	13·5	10 1	1·0	74·8	1181
	Average		18,767					857

From the results shown it will be seen that in the first series of experiments, practically identical rendements of cane (both plant and stubble) were obtained by the two methods of planting respectively. The second series showed a slight advantage for the stripped canes, amounting to about 1½ tons of cane per hectare. However, the climatic conditions during this second series (1914–16) were so adverse, and the cane suffered so much from frost and drought, that really normal development of the crop was not obtained, so that the difference of 1½ tons per hectare might have been due in this case to experimental error.

---

[1] *Revista Industrial y Agricola de Tucuman*, 5, 380, *I.S.J.*, 1915, 183

In respect of sugar per hectare a certain uniform superiority is noticed in the cane stripped by hand, amounting in the average of four years to 185 kg. per hectare. Further investigation is necessary to confirm this, and if it is confirmed, to discover its cause.

THE AFTER-RIPENING OF CANE: CHEMICAL CHANGES WHICH TAKE PLACE AFTER CUTTING. *J. H. Barnes*. *Agricultural Journal of India*. 1917, *12*, 200-215.

Among the *zamindars* in the Gurdaspur District of India, it is a fairly common practice for the peasant farmer to allow his stripped cane to remain in heaps for a day or two before crushing, the reason given being that the *gur* obtained from such cane is drier and lighter in colour than that got from cane immediately crushed. If this is so, and if the ripening of the cane may be regarded as a water starvation phenomenon, then the loss of a limited amount of water will result in ripening off the cane, and if this is in an unripe condition when cut, the benefits may be more than the milling losses.

In order to test this theory of the ripening-off of cut cane, a number of experiments were made on the effect of storing on the chemical composition of the juice. In all cases the cane, mostly of the *Katha* or *Chin* variety, was cut and stripped of leaves in the usual manner, a part being crushed and the juice at once examined, while the other part was kept in the laboratory for 24 or 48 hours after which it was milled and the juice examined. Sometimes the cane stems were coated with paraffin wax to prevent loss of moisture ; in some cases the cane tops were removed ; while in others they were left attached.

As the results of numerous experiments, it was found that about 55 per cent. of the cane showed an increase in sucrose, indicating that ripening had continued, while the remainder showed a decrease though not a great one, indicating that sugar decay had commenced. It was thought that artificial dehydration of the cane might accelerate saccharogenesis, and so samples of *Katha* (both ripe and unripe) were cut into lengths of one internode, and preserved in a desiccator over sulphuric acid. Under the conditions of the experiment, the results, however, showed that desiccation had led to a decay of sucrose almost in every case, and it seemed as though the reaction affecting the sucrose had been so rapid that in every case the optimum time of storage had been passed.

It is evident, therefore, from these results that there is some scientific foundation for the custom practised in the Gurdaspur District of storing cut cane before crushing. From the observations made this tends to further ripening, but it is clear that it is attended with danger of losing sugar if the storing is continued for too long a period. As to the length of time for which the cane may be stored without suffering a loss of sugar, and during which an actual increase in the amount of sugar in the juice will take place, this will vary with the temperature of the atmosphere and the condition of the cane. It will be shorter as the temperature rises. On the other hand, excessive cold including too great a change in temperature, may also bring about losses in sucrose, probably owing to suspended activity of the cell protoplasm, resulting in a loss of control of the ordinary fermentation changes normally taking place there.

The Java system of covering cut cane with damp trash, to which attention has been drawn by DEERR,[1] is to keep to cane stem alive. By this treatment the cane will be maintained at a uniform temperature, and being in a moist atmosphere will not lose water. Depending upon the temperature and condition of the cane, for a limited time there should be an increase rather than a decrease in the sucrose content of the cane with this practice. On the other hand, moist heat will not only induce the growth of moulds, fungi, and bacteria, all of which bring about fermentation changes, but once the cell is dead it will induce rapid decay in the cell contents by hydrolysis and oxidation. This after-ripening of cane is a matter of some importance to the factory owner, who at any time may be forced to store the cut cane owing to a break-down of the mill. Probably, therefore, the chemical changes here outlined will be of interest to him, as well as to the student of the chemistry of sugar.

CHEMICAL FILTER-PAPER. *E. J. Bevan and W. Bacon.* *Analyst, 1916, 41, 159-165.*

Prior to the war, 500,000 to 600,000 lbs. of filter-paper of all grades were imported into this country, but at the present time British firms are putting excellent qualities of this material on the market, and now a certain amount is being exported. For most filtering purposes a paper should possess the character of "softness," the technical term for which is "bulk," which defines the relation of the volume of the paper to that of the fibre. Generally, for a moderately rapid paper the bulk should be about 3·5, fibre being 1. Pinholes sometimes occur in papers of this class, and are due to faulty manipulation of the beaten "stuff" at the mill. Cotton cellulose is preferable to linen cellulose in the manufacture of high-grade filter-papers, owing to its lower hydrating power, and to the fact that it imparts more bulk. Lime in filter-paper is chiefly derived from the water used in manufacture, while chemical bleaching also contributes to the amount of this impurity. Iron and copper, and sometimes alumina and silica, may be present in low-grade qualities; but starch and oil are the chief impurities in filter-paper, both being derived from the material, though for the greater part removable by the chemical treatment and washing.

NATURE OF THE REDUCING SUBSTANCES PRECIPITATED BY BASIC LEAD ACETATE FROM IMPURE SUGAR SOLUTIONS. *H. Pellet.* *Annales de Chemie analytique, 1916, 21, 217-223.*

When a solution of molasses is treated with basic lead acetate, the precipitate produced contains a considerable quantity of a reducing substance. This consists of invert sugar itself, or of a mixture of its constituent sugars; for when the lead precipitate is separated and decomposed by sulphuric acid, the resulting solution is levo-rotatory, and the sugar it contains ha the reducing power of invert sugar and is completely fermentable by yeast. Hence, the reducing substance cannot be *glutose*, as stated by DAVIS,[2] this sugar being optically active and unfermentable. If an invert sugar be treated with an equivalent quantity of basic lead acetate and sodium sulphate, the precipitate formed may contain up to 60 per cent. of the invert sugar present, but the latter can be recovered by decomposing the precipitate with sulphuric acid. Normal lead acetate is recommended for the clarification of molasses solutions, calcium salts and excess of lead being removed from the solution before the copper reducing power is determined.

SOME DETERMINATIONS OF MARC IN AMERICAN BEETS. *C. J. Bourbakis.* *Sugar, 1917, April, 138.*

Different methods have been proposed for the determination of the marc or dried insoluble matter of the pulp composing the membrane of the cells, these varying somewhat regarding the temperature of the water used for exhaustion. In the present determinations von Lippmann's instructions were followed, the residue being finally washed with alcohol and ether in order to dissolve the fat and aromatic and colouring substances of the beet. Ten determinations were made on Californian roots, the numbers under column A showing the marc percentage of the pulp, plus sand mechanically mixed, and also the ash present; while those under column B denote the pure combustible marc, or the figures given in the first column minus the sand and ash, this being the method preferred by several writers :—

---

[1] "Cane Sugar" by Noel Deerr, page 59.

[2] *I.S.J.*, 1916, 168.

Test Number.	A. Per cent	B. Per cent.
1	4·89	4·65
2	5·24	4·96
3	4·92	4·79
4	5·20	5·04
5	4·40	4·28
6	4·24	4·08
7	5·11	4 88
8	5·01	4·70
9	5·26	5·08
10	4·55	4·39
Average	4·88	4·68

Taking the specific gravity of the marc as 1·6, according to Tollens and Pellet, the volume occupied by the marc of 26 048 grms. of beet is found to be 0·79 c.c. But Pellet and Maercker have pointed out that the difference between high and low beets as regards marc is a difference, not in the quantity, but rather in the state of hydration of that substance, the marc of high beets being imbibed with more water than in the case of low ones.

Inheritance of Certain Stem Characters in Sorghum. *G. R. Hilson. Agricultural Journal of India, 1916, 11, Part 2, 100-155.*

Attention has already been drawn[1] to the occurrence in some strains of selected sorghums of two distinct types differing as regards the appearance of the midrib of the leaf. In one the midrib appears as an opaque white band running the whole length of the leaf; while in the other the midrib of the lower leaves is marked by a dull white, generally broken, band, never extending across the full length of the midrib and rarely to the end of the leaf; the midrib in the upper leaves being devoid of any white marking whatever. A greyish midrib has been definitely shown to be associated with a stem rich in sugar, and a white midrib to be associated with a dry pithy and tasteless stem.

Tests have now been carried out on the inheritance of these characters with the result that the pithy character of the stalk has been shown to behave as a simple dominant to the sweet-stalked character. The differences in the characters of the midribs of the leaves do not become apparent in the plants until these latter are about 6 to 7 ins. high.

Use of Nitrate of Soda and Sulphate of Ammonia on Sugar Cane Plantations in Java. *J. M. Geerts. Mededeelingen van het Proefstation voor de Java-Suikerindustrie, 1916, 6, No 9, 223-305.*

Experiments have been carried out in Java during the last few years to compare the manurial value of sodium nitrate and ammonium sulphate for sugar cane. These have shown that ammonium sulphate gives the best results on sandy soils and sodium nitrate on heavy land. Where nitrate was used no deleterious action on the structure of the soil was observed, nor is there any likelihood of this occurring in Java as the nitrate is not applied every year and further the land is irrigated. Owing to its extreme solubility, nitrate is specially adapted to regions of low rainfall, and gives the best results when applied in two or three dressings. It did not retard the ripening of the crop. In Java ammonium sulphate is the more suitable manure in the majority of cases, and, unless supplies fail or the price of nitrate falls, it will continue to be the more popular of the two fertilizers.

J. P. O.

---

[1] Benson and Subba Rao. The Great Millet or Sorghum in Madras. *Bull. Dept. Agr., Madras.*

Review of Recent Patents.[1]

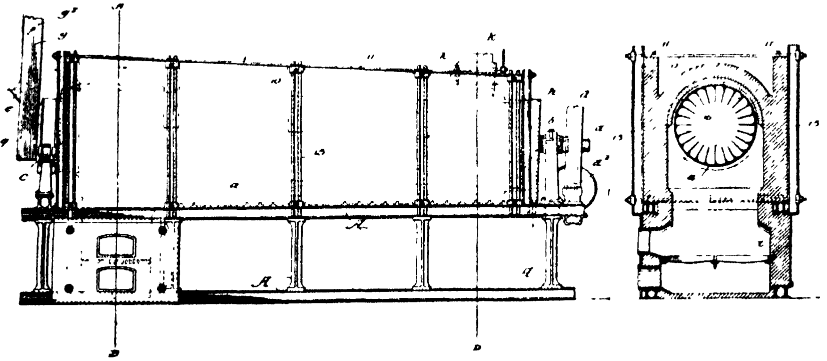
UNITED STATES.

Revivification and Decarbonization of Animal Charcoal (Bone-black) and its Substitutes. *Moriz Weinrich*, of New York, U.S.A. *1,184,397.* Patented, May 23rd, 1916.

Briefly stated, the apparatus comprises a drum *a*, preferably set at an incline, capable of revolving in the bearing *b* and supporting rollers *c*. At one end there is a projecting shaft *d*, carrying a worm gear d^1, suitably engaged by a worm d^2; while at the other and higher end there is a spout *e* through which the bone-black to be treated is admitted to the drum, an outlet *f* being provided at the lower end for its discharge. Fitted to the inlet end of the drum is a hood *g*, which has an extension g^1, forming an air and vapour uptake, and containing a damper g^2. At the outlet end of the drum and fitting over it is a hood *h* with a sliding damper to control the draft of atmospheric air to be maintained.

The drum is mounted within a casing *15* of brickwork of any desired construction, supported upon a frame-work *A*, in which heat is generated, the products of combustion from coal, coke, oil or gas, being caused to pass upwardly into the casing surrounding the drum, finally leaving the casing through the flue *k*. The heat escaping may be utilized for heating a dryer erected between the apparatus for the bone-black before it enters the drum.

The material under treatment enters through the spout *e* in a regular stream, while the drum is slowly rotated, the rate being 1 rev. in 2 mins. for a drum 25 ft. long with a diam. of about 4½ ft., set at an incline of about 1 ft. As soon as it enters it is caught up by suitable blades *16* on the inside of the drum, these having the function of lifting and dropping the material, while sifting it through perforations on the blades and over their edges in the form of thin streams, in which condition it is exposed to the action of the air current, and any moisture is carried away, passing out with the air through *g* and g^1.



Oxidation of the organic impurities begins at about 300°F. (150°C.), which temperature will be increased while the material is being moved bodily by lifting and dropping toward the rear end to 500°–550°F. (260°–287°C.), when simple revivification is required; and to 600°–700°F. (315°–375°C.), if simultaneously 0·5–1·0 per cent. of carbon is to be removed. If previously revivified dry bone-black is to be decarbonized, the temperature may reach 800°F. (430°C.), and about 2 per cent. of carbon be removed by each treatment.

The whole process may be carried out in about 40 mins., and a standard-sized machine will hold about 4000 lbs. on its blades and bottom. The temperature will fluctuate but little, and is capable of easily being regulated by the fire in the furnace. As the bone-black is not lifted high and drops slowly always on itself, practically no dust will be formed. In ordinary kiln work, the temperature has to be brought to a red heat of about 1200°F. (650°C.) and maintained for half-an-hour, so that the saving in fuel alone by this process should be considerable. The life of the drum, when made of welded steel, is 8–10 years.

---

[1] Copies of specifications of patents with their drawings can be obtained on application to the following:—*United Kingdom:* Comptroller of the Patent Office, Southampton Buildings, Chancery Lane, London, W.C. (price, 6d. each). *United States:* Commissioner of Patents, Washington, D.C. (price 5 cents each). *France:* L'Imprimerie Nationale, 87, rue Vieille du Temple, Paris (price, 1 fr. 05 c. each). The date given in the heading of United Kingdom specifications is that of the application of the patent.

Among further advantages alleged in favour of this process of gentle oxidation as compared with dry distillation is that the mineral framework of the char is left intact, leaving the cells always open, while the impurities are oxidized. On the other hand, with the process of dry distillation at a red heat, the mineral framework shrinks and the organic matter unconverted into gas is deposited in the cells, gradually closing them, reducing the original surface, and consequently diminishing the efficiency of the char. Iron is converted into ferric oxide, whereas by the process of dry distillation it would exist as sulphide. In like manner any lime is converted, not into sulphide, but into sulphate, which is capable of removal by washing

CONTINUOUS FILTER-PRESS *Frederick J. Wagner*, of Santa Ana, Ca., U.S.A. *1,119,736.* Patented, December 1st, 1914.

In the operation of this machine, power being applied to the drive pulley on the shaft *15*, the belt and chain are slowly advanced in adjacent position through the filtering casing, and the liquid to be filtered, e.g., sugar juice and milk-of-lime, is introduced through *54* into the first chamber *49* of the casing where all the insoluble portions are caught upon the floor formed by the belt *26* which is intimately pressed in contact with the screened plate *51*, the filtrate carrying the sugar in solution escaping through the orifice *55* to any suitable container. The belt (formed of an endless fabric of suitable thickness) now advances through the pressure box *56*, the speed being so timed that the cakes resultant from the filtering process practically fill the pockets in the chain, and the cake is exposed to the action of water introduced through the inlet in the casing *57* where all the undissolved sugar is washed out, the pressure of the dissolving medium being preferably slightly greater than that in the first filtering chamber, but not in excess of that applied to the pressure box *56* and *61*. In travelling through the latter chamber, all the soluble ingredients are eliminated and the resultant cake consisting of calcined carbonates together with sand, and other contaminating ingredients commonly found with the lime

FIG 1

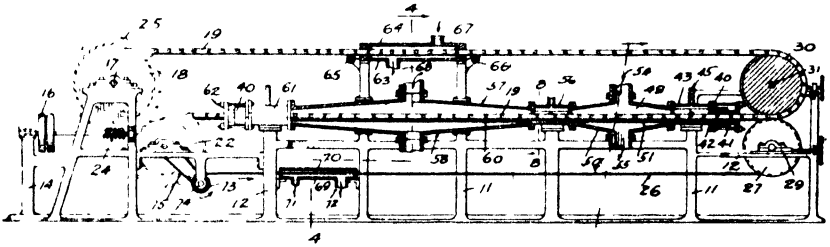
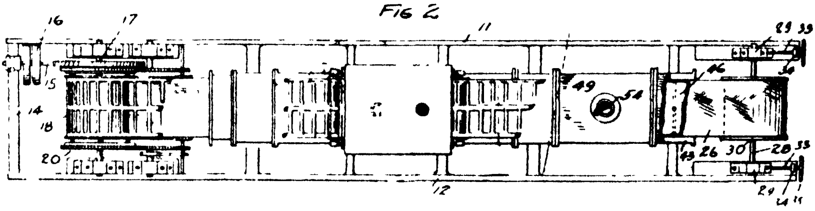


FIG 2

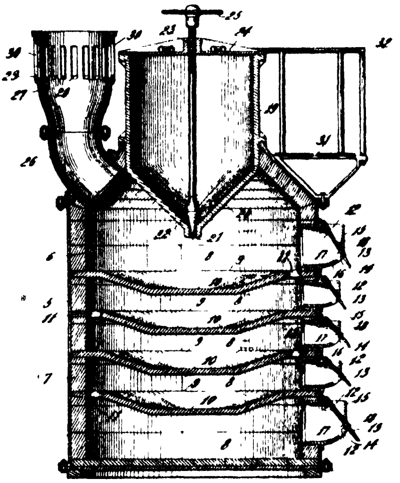


when introduced in the process, fall off the belt, or are removed by the brush *73*, and any particles which may become embedded in the fabric are washed out in the washing box *69*. Particles adhering to the roll also fall by gravity, the drum *18* being preferably placed in the position beyond the drum *22* so that this action is assisted by this extension of the chain in a horizontal position beyond the belt, the chain being supported and washed in the washing box *63* provided for it, the current of the fluid passing through the pockets formed by the links and the sleeves.

CONTINUOUSLY ACTING SULPHUR OVEN. *Albert G. Hinzke*, of Rothschild, Wisconsin, U.S.A. *1,149,765*. Patented, August 10th, 1915.

Referring to the drawing, *5* indicates the casing forming the combustion chamber *6* which is of annular form closed at its top and bottom portion, and lined with fire-brick *7*. It is divided vertically into compartments *8*, *8*, by annular horizontal partitions which form the fire trays *9*. These trays have depressed medial portions *10* for holding the sulphur and also have semi-circular holes *11* which permit the air for combustion and the sulphurous gases to flow upwardly therethrough.

The front portion of the casing is provided with an air inlet opening *12* for each compartment and each opening is controlled by a hinged door *13*, which may be swung to an adjusted position and held in position by means of a pin *14* extending through one of a series of perforations *15* formed in the side portion of the opening frame *16*. The doors are provided with small openings *17* covered by revoluble damper doors *18* which may be opened to view the condition of the burning sulphur on the trays in order to adjust the draught of the doors.



The charging receptacle *19* has its conical bottom portion *20* extending centrally into the chamber and at its lower end is provided with a discharge opening *21* controlled by a needle valve *22*. It extends sufficiently far into the combustion chamber to be in the path of circulation of the hot gases to receive the heat therefrom so that the sulphur placed within the receptacle will be reduced to a molten mass.

An outlet pipe *26* is provided with an enlargement at its upper end to form a supplemental combustion chamber *27* through which the gases pass and undergo a final combustion. The upper end portion of the outlet pipe is provided with a circumferential line of elongated air inlet openings *28* through which air enters to complete the combustion of the sulphur. The flow of air through the elongated air inlet openings *28* is controlled by means of a sleeve valve *29* which surrounds the supplemental chamber and is provided with a series of elongated openings *30* which may be moved into register with the elongated openings of the said chamber.

In operation the receptacle is charged with sulphur Sufficient is placed on the upper tray and ignited to provide heat to melt that in the receptacle As soon as melted, the needle valve is turned to open position to permit the sulphur to flow into the upper tray. The tray upon filling up will overflow and charge the next tray below and as soon as this tray is filled it will likewise overflow and charge the next, which overflowing of the different trays will continue until all of the trays are charged with the burning sulphur By regulating the feed of sulphur with relation to the burning all of the trays may be kept supplied and the operation of burning may be made continuous and the feed automatic.

The sulphur gas or fumes in passing through the supplemental combustion chamber is subjected to a final burning which tends to produce a more uniform grade of gas.

Application for Amendment.[1]

Preparation of Decolorizing Carbon. ***Alfred H. Bonnard,*** of Ivanhoe Hotel, London, W.C.; ***T. E. Rule,*** of 22, Percy Street, Liverpool; and ***James Nicol,*** of 60, Addlingham Road, Liverpool. *10,622.* Applied for, July 31st, 1915.

As reasons for their application to amend the patent already published,[2] it is urged by the inventors "that we are advised that the specification and claim in its present form is too indefinite in view of known processes and Clause No. 1 requires restriction to differentiate it from such processes." The proposed amendments are as follows:—

On page 2.—*Line 21.* Inserting "in a retort excluding air" after "heating" and substituting "mixed with" for "in the presence of a". *Line 22.* Inserting "calcium" before "carbonate" and striking out "(or oxide) of an alkaline earth metal (for example calcium)". *Line 23.* Inserting "introducing both of the substances into the retort in a dry state and" after "by". *Line 24.* Inserting "calcium" before "carbonate," striking out "(or oxide) of an alkaline earth metal" and "a bright red heat" and substituting "about" for "(about)" *Line 25.* Substituting "1000° C." for "1000° C.)" *Line 45.* Inserting "calcium" before "carbonate" and striking out "(or oxide) of an alkaline earth metal (for example" *Line 46.* Striking out "calcium)".

On page 3.—*Line 4.* Inserting "A free discharge of carbon monoxide takes place from the vent of the retort at about 1000° C. and the occurrence of such discharge may be used as a general index of the temperature scale, as evidence that the process is complete. If the process be stopped when carbon monoxide is first given off, the activity of the charcoal will be less than that of charcoal produced after a free discharge has taken place" after "less" *Line 13.* Striking out "or other carbonate (or oxide) of an alkaline earth metal". *Line 21.* Inserting "in a retort excluding air" after "heating". *Line 22.* Substituting "mixed with calcium" for "in the presence of a" and striking out "(or oxide) of an". *Line 23* Striking out "alkaline earth metal (for example calcium)" and substituting "by introducing both of the substances into the retort in a dry state and" for "by". *Line 24.* Striking out "alkaline earth metal" and "a bright red heat" and substituting "about 1000° C." for "(about 1000° C)". *Line 30.* Striking out "bright red heat" and substituting "about 1000° C." for "(about 1000° C.)"

UNITED KINGDOM APPLICATIONS.

Producing a variable determined Level in Evaporators. ***E. Barbet et Fils et Cie.*** *1156.* January 23rd, 1907. (France, April 10th, 1916.)

Continuous Separation of Solids from Liquids. ***A. Bontemps and G. N. Vis.*** *3866.* March 16th, 1917.

Centrifugal Separator and Filter. ***G. Calvert.*** *3981.* March 19th, 1917.

Production of Decolorizing Carbon. ***R. von Ostrejko.*** *4813.* April 3rd, 1917

Anti-priming Devices or Baffle-Plates for Evaporators, etc. ***H. Fay.*** *5432.* April 18th, 1917.

Evaporator ***J. L. Major.*** *5915.* April 26th, 1917.

Analytical Pipettes. ***P. E. Spielmann.*** *6107.* April 30th, 1917.

Manure Manufacture. ***A. D. Furse.*** *6182* May 2nd, 1917.

Spindles for Centrifugal Machines. ***A. R. Robertson.*** *6770.* May 12th, 1917.

Continuous Centrifugal. ***O. Sheppard.*** *6735.* May 11th, 1917.

Colouring Bodies for Food. ***A. Boake, Roberts & Co., Ltd.*** *7105.* May 17th, 1917.

Treating Phosphoric Acid to be used as a Clarifier. ***Kwanto Sanso Kabushiki-Kaisha, U. Emura, and T. Hayashi.*** *7175.* May 18th, 1917. (Japan, July 22nd, 1916.)

Macerating Crushed Cane. ***C. McNeil.*** *6824.* May 14th, 1917.

Centrifugal Machine. ***G. H. Elmore.*** *7612.* May 26th, 1917.

Manufacture of Alcohol and other Products from Molasses. ***G. H. Hughes.*** *7324.* May 21st, 1917.

Fermentation Processes. ***C. Wiezmann.*** *7552.* May 25th, 1917.

---

[1] *The Illustrated Official Journal* (*Patents*), April 25th, 1917, page 343.

[2] *I.S.J.*, 1917, 241

United States.

(Willett & Gray, &c.)

(Tons of 2,240 lbs.)	1917 Tons.		1916. Tons.
Total Receipts January 1st to June 14th	1,530,353	..	1,581,365
Receipts of Refined ,, ,, ..	—	..	—
Deliveries ,, ,, ..	1,482,548	..	1,491,888
Importers' Stocks, June 13th	58,770	..	93,555
Total Stocks, June 13th	331,663	..	229,624
Stocks in Cuba, June 13th	760,921	..	799,970
	1916.		1915.
Total Consumption for twelve months	3,658,607	..	3,801,531

Cuba.

STATEMENT OF EXPORTS AND STOCKS OF SUGAR, 1914-1915, 1915-1916, AND 1916-1917.

(Tons of 2,240 lbs.)	1914-15 Tons		1915 16 Tons		1916-17 Tons
Exports	1,383,563	..	1,788,338	..	1,753,869
Stocks	751,720	..	881,802	..	756,982
	2,135,283		1,670,140		2,509,851
Local Consumption	37,430	..	39,560	..	48,500
Receipts at Ports to May 31st, 1917	2,172,713	..	2,709,700	..	2,558,351

Havana, May 31st, 1917 J. GUMA.—L MEJER.

United Kingdom.

EXPORTS OF SUGAR.

	MONTH ENDING MAY 31ST 1916. Tons		1917 Tons.		FIVE MONTHS ENDING MAY 31ST. 1916 Tons.		1917. Tons.
BRITISH REFINED SUGARS :—							
Refined and Candy	221	..	74	..	3,371	..	519
Total	221		74		3,371		519
FOREIGN AND COLONIAL SUGARS :—							
Refined and Candy	90	..	—	..	529	..	6
Unrefined	7	..	48	..	62	..	326
Various Mixed in Bond	—	..	—	..	—	..	—
Molasses	2	..	4	..	541	..	12
Total Exports	**320**		**126**		**4,503**		**863**

THE

INTERNATIONAL

SUGAR JOURNAL.

No. 224. AUGUST, 1917. Vol. XIX.

☞ All communications to be addressed to "The International Sugar Journal," 2, St. Dunstan's Hill, London, E.C.

Cheques and Postal Orders to be made payable to "The INTERNATIONAL SUGAR JOURNAL," and not to individuals

☞ The Editors are not responsible for statements or opinions contained in articles which are signed, or the source of which is named.

The Editors will be glad to consider any MSS. sent to them for insertion in this Journal and will endeavour to return the same if unsuitable; but they cannot undertake to be responsible for them unless a stamped addressed envelope is enclosed.

Notes and Comments.

The Fourth Year of War.

With this month we enter on the fourth year of war. While it would be futile to deny that all Europe is more or less weary of the prolonged struggle, the resolve of the Allies to persist till a conclusive outcome is reached remains unimpaired, while the cause they have made their own is so convincing to all impartial observers that it has led one country after another that was formerly neutral to throw in its lot with the nations who are fighting to uphold democracy and overthrow Prussian autocracy with its lust for domineering the smaller nationalities. The United States has set the example to the New World in unmistakable fashion, and her decision to oppose Germany's aims has been promptly seconded by some of the smaller American states, whose independence is menaced by Germany's programme. The nations of the world then are virtually unanimous in resolving to put down once for all the German menace to international peace; with all that has happened during the last three years still uneffaced from their memory, their motto is, as Mr. Lloyd George well expressed it the other day, "No *next time.*". An inconclusive peace now simply means asking for further trouble within a score of years. If this peril to mankind is only scotched, there would be later on a recrudescence of the struggle on a scale which would make even the present one pale into insignificance. Hence our firm resolve to continue to a victorious end, cost what it may. In this resolve the great American nation are steadily uniting and their decision to see it through on their own part will greatly strengthen the will and the power to conquer amongst the original allies.

The New Food Controller.

Lord Devonport found the office of Food Controller too exacting for his health and retired from it last month; and he has been succeeded in that admittedly thankless task by Lord Rhondda, the Welsh colliery owner, who is reputed to be a man of marked business ability and no little determination to have his own way when he thinks the circumstances demand it. It was not easy for the Prime

Minister to fill the post, and he has made an excellent choice. Lord Rhondda has only been a few weeks in harness, but has already given evidence of good intentions. Realizing from the outset that the high price of food is an incentive—indeed the chief one—to industrial unrest, of which there is undoubtedly a good deal in existence all over the country, he has taken steps to have the prices of some chief articles of food lowered to a more reasonable figure, even though it may mean that the Exchequer will be called upon to make good certain differences between buying and selling prices. The high price of certain articles of food is undoubtedly due to the intervention in the transaction of profiteers, and these gentry are to be eliminated as much as possible in the future. This reduction in the current prices of food was considered preferable even by the labour organizations to the alternative of raising wages, and as one or the other had to be done, something is to be knocked off the retail price of bread and meat at as early a date as can be arranged.

Sugar is in a somewhat different category. It has been a Government monopoly since the outbreak of war and the price at which it is sold does not bear any precise relation to supply and demand, nor is it artificially bolstered up by the intervention of profiteers. Complaint centres here not on the price but solely on the quantity available. However the Government evidently consider that the present allowance of ½ lb. per head per week is sufficient to meet all bare necessity, and it happens to coincide with the trend of quantities lately imported. Possibly the imports may increase during the next six months; it is clear from official revelations that the chief task of the shipping controller the last three or four months has been to augment the reserve stocks of cereals in this country, and we have been allowed to know just recently that they now stand at a much safer level than they did in the Spring, though not yet plentiful enough to make it a safe proposition to relax the restrictions on bread consumption. Failing any undue increase in U-boat successes, it is probable that more shipping may be available this Autumn for bringing sugar to this country, and as the Government are widely credited with having bought very largely in Java sugar, it must be supposed they have worked out the problem of getting it from Java to the United Kingdom, bar accidents and unforeseen misfortunes. But their chief duty will be to try and build up a reserve in sugar too, so it will not follow that an increased importation will immediately lead to an increased consumption, though the original ration of ¾ lb. per head per week might be reverted to as soon as feasible. The more urgent task is to ensure that the whole population gets its sugar allowance, and that is a task that has yet to be accomplished, as it is notorious that owing to sugar being apportioned on the basis of the 1915 consumption, a large number of mushroom colonies of workers round new munition centres have been unable to secure their rightful quota.

The Advent of Sugar Cards.

The new Food Controller has realized this inequality, and has decided that some form of documentary aid is advisable for all purchasers of sugar. He has deliberately decided against the introduction of any system of compulsory rationing by sugar tickets; but he proposes to introduce a system of sugar cards for all householders, which will state their allowance and give them the first choice of the available sugar supply, at the same time enabling the retailers of the sugar to gauge with some exactitude the amount of sugar required by their customers from week to week. As is described elsewhere, the new scheme entitles every householder to apply to a local food committee for a sugar card on which will be written the amount of his household sugar allowance, and this card will serve as a basis for the householder to register at his customary grocer and draw his weekly allowance. It will also enable the retailer to apply for a definite amount of sugar from the wholesaler. The scheme is not compulsory; but as registered customers are to have the first claim on the grocer's supply, and the latter is ultimately to be rationed mainly if not exclusively on the total requirements of his registered customers, it appears to be a sine quâ non that all those who want to be certain of a regular supply will have to apply for sugar cards and register at an authorized retailer's store. At present it is not easy for retailers to refuse demands for sugar from outside customers, and even less easy to refuse demands for extra sugar from regular ones; but the new regulations would appear not only to allow the refusal in either case, but to provide no sugar at all for casual purchasers. The hoarder who buys from shop to shop will thus be eliminated, while false statements as to the size of households will be checked sooner or later by the authorities concerned, and suitably penalized. By this new scheme it is hoped that whatever sugar is available will be divided equally between all classes. At the same time certain petty inconveniences will tend to crop up and may need allowing for. The case of the large number of families who when on holiday do their own catering, the case of visitors, and finally, the case of casual labour in households, are not yet recognized and will need some adjustment in the regulations or complaints will be strong.

The Local Food Committees, it should be noted, are to be drawn up by the local authorities—the municipal corporations and the urban and rural councils—who being normally charged with the collection of local rates have complete lists of the households within their borders. By this means it is hoped that every household will be approached and urged in its own interests to apply for a sugar card. These committees are, however, not concerned solely with the distribution of sugar; they have been assigned a number of tasks relating to the distribution of food generally, and the regulation of the current prices at which it may be sold. And their labour promises to be a fairly arduous one.

Government-aided Central Factories in Jamaica.

With the way now clear for the governments of the Crown colonies in the West Indies to offer financial aid to central sugar factory ventures, proposals for the erection of such factories are taking shape.[1] Sir FRANCIS WATTS recently concluded a lengthy visit to Jamaica where he conferred with the sugar planters on the problem of erecting centrals in that island, and put forward a number of proposals which involve *inter alia* the resort to direct Government financial co-operation. He suggested that a limited liability company should be formed to work a factory, to be financed by means of Government debentures and controlled by directors appointed both by the Government and by the contracting planters.

The outlined agreement, on the strength of which the Government of Jamaica would afford assistance on business lines, provides that the cane growers of a district shall associate themselves together under contract to cultivate a sufficient acreage in sugar canes to keep a factory employed and shall form a company, the shares of which shall be assigned to the Government to be held by the latter as security for interest in the factory, and in return the Government shall advance to the company a sum agreed upon for the erection and working of the factory. This sum is to be secured by 6 per cent. debentures redeemable by a sinking fund of 4 per cent., whereby it is calculated that they may be redeemed in about 20 years if not earlier. During such time as the debentures are outstanding the Government shall in addition to the interest on the debentures receive one-half of the net profits of the factory, and for five years after the debentures are redeemed one-fourth of the profits. After that the Government will transfer the shares back to the company which will distribute them to the cane growers in proportion to the canes delivered by each. But these shares are not to receive any interest and only entitle their holders to certain voting powers.

---

[1] See also *I.S.J.* 1917, 52.

The cane growers on their part are to be bound to supply canes to the factory from the acreage stipulated for the whole of the period during which the Government have an interest in the factory, including the five years during which the Government receives one-fourth of the profits. Besides being paid for their cane, they will be entitled to receive their respective proportions (based on tonnage of cane supplied) of the net profits of the company which, once the Government interest in the concern is redeemed, will amount to the whole sum. For his canes, the contracting cane grower is to receive the local value of 5 lbs. of grey crystal sugar of 96° test for each 100 lbs. of canes delivered, that is 1s. per ton of cane for each £1 per ton the local sugar is worth. Thus if the latter is worth £12 per ton, the canes are to be paid for at the rate of 12s. per ton.

In conclusion, it may be said that these proposals (which while proving no bad business deal for the Government are destined ultimately to work the factories on the most advantageous terms, viz., on the co-operative principle whereby the growers of the cane and no others are interested in the profits of the factory) have been approved by the Governor and Legislative Council of Jamaica; and it is consequently to be hoped that no time will be lost now in translating them into action and drawing up the plans for the early erection of several such central sugar factories in the cane districts of our largest West Indian Crown colony.

An American Refinery Fire.

On June 13th an explosion and fire took place at the American Sugar Refining Company's Brooklyn refinery, the scene being the powdered sugar milling department; it was of a sufficiently serious nature to cause some loss of life, and injury to a number of employees, and it seriously damaged an important part of the building, thereby putting part of the refinery for the time being out of commission. Very prompt steps were taken by the company to restore the plant to working order again, and by June 19th the power and sugar lines had been connected up with the remaining buildings, and the production of sugar resumed. A fortunate circumstance for the company was that three days previously the large Reserve refinery at Philadephia had been placed in operation, and thus offset the effect upon production.

The cause of the explosion does not appear to be known as yet; there were naturally rumours of foul play, but the officials of the company were loth to give credit to them without some definite evidence. The fact that the explosion occurred in the powdered sugar milling department is at least suggestive of a purely accidental cause; it would be just in such a department that sugar dust would be prevalent, and it has been proved in this country by expert investigation[1] that sugar dust is readily inflammable, the source of heat required for ignition being comparatively small, such for example a lighted match. Sugar dust can in fact be ignited when projected as a cloud against a surface heated to below red heat; again, given sufficient time for contact between sugar particles and a source of heat, destructive distillation of the dust and the evolution of inflammable gas can ensue, in which event the temperature of ignition would be approximately that of the inflammable gases evolved, which may be as low as 540° C. And when such an ignition of gas and air does take place, the sequent explosion may ignite an adjoining layer of dust and air, thereby greatly extending the ramifications of the explosion.

---

[1] See *I.S.J.* 1915, 301.

Tractor versus Horse Power in the United States.

A writer in the *Farm Implement News* endeavoured recently to compare the comparative cost of motor tractor and horse power as used in the United States. The working cost of a motor is easily arrived at, and for a $1000 8-H.P. tractor the maintenance charges including interest on capital and depreciation work out at $468·87 per annum. The cost of upkeep of a horse varies widely and has doubled within the last fifteen years; in 1914, the last pre-war year, it was officially estimated at 129 dollars per annum, while in 1916 the figure was reckoned at as much as 167 dollars. On an average 160-acre farm, the smallest that can be economically worked with a tractor, at least four would be needed; they would cost (in the States) $250 each to buy and the maintenance charge would be $668·76 for the four. Hence while the first cost of either form of power would be the same, the tractor would cost $200 per annum less to maintain than the four horses.

Comparative figures of a day's work, allowing 1000 hours a year, place the cost of a horse at 16·7 cents per hour, or 66·8 cents for the four; whereas the tractor for the same number of hours annually costs 46·8 cents per hour. The writer in our contemporary adds that as the tractor is of 8 H.P., the cost per horse-power-hour is only 5·8 cents, an advantage in favour of the tractor of nearly 11 cents over the four horses. But the indicated power of a good horse is considerably more than that of a mechanical H.P., while the comparison is never really constant, so it seems to us that the only fair comparison is one which takes the work of the motor as a whole without reducing to units of H.P.

In fixing the rates of depreciation, that of the motor is reckoned at 20 per cent., as the life of a tractor is not a long one, whereas the annual depreciation of the horses is put at only 10 per cent.

Decimal Currency.

The advantages of the metric or decimal system are undeniable, and it is somewhat curious that the two great Anglo-Saxon races of the world have as yet only partially adopted it. The United States have indeed a decimal coinage, but they are not any nearer to adopting metric weights and measures than we are in this country. We on our part have not even a decimal coinage, consequently the conversion from our monetary system to that of the decimal coinage countries, which constitute the vast majority, is a more or less cumbrous task. The war has undoubtedly helped to emphasize the isolation of the British system, and there is now a strong and increasing body of opinion which advocates our bringing our measures into line with those of other countries, and suggests that a beginning might be made with our coinage which presents the fewest obstacles to the change.

Expert opinion is, however, divided as to the unit value to be adopted and its fractional division. Thus we find the Bankers' Institute, while fully in favour of a decimal coinage, expressing the conviction that the present pound sterling must remain the unit and be divided into a thousand parts to be called *mils*, a mil being approximately equal to one farthing (960 farthings = £1). Thereupon 4 mils would equal the old penny, 100 mils the present florin, and 500 the half-sovereign, while a new coin preferably of nickel might be introduced to represent 10 mils. They prefer *mil* to *cent* because a cent of that value would only equal half an American cent. Three places of decimals would be needed, but the total number of figures in the row would not be increased.

On the other hand, there are the advocates of the double florin as unit, in which case the pound sterling would equal $5, and the conversion would bring the monetary fractions in line with North American currency; the double florin would be 100 cents or equal to the dollar, one shilling would be 25 cents, a halfpenny one cent, while the pound would be 500 cents.

The difference between the two systems is that the former makes the pound the unit, while in the second case the pound is only found after a division by 5. The *mil* system undoubtedly suits our present coinage the better in that it preserves the pound as a common standard, but when compared with other currency coincides more nearly with South American than North American usage. It may therefore resolve itself into the question of which system is the most advantageous to our foreign trade, and whether the upheaval in home transactions which must follow the adoption of the double florin as unit will be sufficiently compensated for by the simplification of overseas exchange. If the double florin is adopted, it must end in eliminating the pound sterling save as a measure of gold standard, since all prices would be in terms of double florins or dollars. But this will perhaps not be so great a disadvantage in the future as it might have been in the past, as it is probable that paper currency has come to stay and that gold will be stored as a reserve for meeting international liabilities.

Whichever system is finally adopted, it is apparent that it is only a matter of time ere the change is made. But when it comes to metric weights and measures, the task will prove a more thorny one. As an instance of the difficulties to be overcome, it may be mentioned that the engineering industries in both this country and the United States have based their measurements from the commencement on the foot as unit, and all their templates, patterns and jigs, as well as their mechanical drawings, are made to this unit of measurement. The prospect of scrapping all these records and replacing them by others on the metric system is not looked at with favour, as the cost would be very considerable.

The Natal Sugar Industry: An Official Summary.

The "Second Interim Report of the South African Union Government's Advisory Committee on the Control of Food Supplies and other Necessaries" contains some references to the Natal sugar industry. The latter, it is stated, in its present form commenced with the introduction of the Uba cane about eighteen years ago, and in 1904-5 the production had risen to 30,000 tons of sugar cane. With the opening of the Zululand coast belt a year or two later, the increase became more rapid, and 50,400 tons were produced in the 1909-10 season. The output for later years has been as follows: 1913-14, 91,766 tons; 1914-15, 98,371 tons; 1915-16, 115,481 tons; and 1916-17, 114,504 tons. The area under cultivation has also increased in proportion.

The cane is grown by over 400 planters, who reap their crop every two years, obtaining usually three crops from each planting, so that all lands cultivated require replanting every six years. In some cases in Natal the planters are also mill-owners, but Zululand planters send their cane to central mills. In these mills the cane is crushed, and, in some instances, the raw sugar produced is also refined; other mills send their raw sugar to the refineries. Thus three mills have refineries attached to them, and their capacity exceeds 60,000 tons of refined per annum. Raw sugar is produced by all the other mills.

The position of the mill and refinery owners at the present time is regarded as a difficult one. Supplies of all chemicals and requirements for sugar making are restricted and their prices doubled and trebled; and renewals and replacements—a very heavy item in all sugar mills—are in many cases unobtainable, so that a breakdown may involve complete stoppage for an indefinite period. The extent of the unexecuted orders for plant is indicated by the fact that one group gave evidence at an enquiry that they had orders to the value of £100,000 still unfilled.

The mills, refineries, and agents have formed a Sugar Manufacturers' Association, which has appointed a small Committee to grade all sugars offered for sale, and this work has been performed daily since the war commenced.

French Crop Figures.

The French *Direction de l'Agriculture* has recently published figures showing the area under beet cultivation on the 1st June last to be 71,822 hectares (177,400 acres), as compared with 77,506 hectares in 1916, and 84,318 hectares in 1915. This gradual decline in production is naturally attributable to the difficulty of obtaining the necessary field labour when French manhood is so greatly depleted for war purposes. The *Journal des Fabricants de Sucre* however expresses the hope that in view of the beneficient influence which sugar beet culture has on the economic production of cereals and meat, and its value in restricting the importations of foreign sugar and thereby improving foreign exchange, the authorities will give facilities for the prompt rehabiliment and improvement of this industry. It may at any rate be assumed that great as are the demands for men on the part of the French military authorities, the entry of the United States into the war and the prospect next year of their armies taking an appreciable share of the work on the Western front will tend if anything to easen the agricultural labour difficulty, and may conceivably allow the French some latitude in the matter of assisting industries of national importance.

Utilization of Waste Molasses in Queensland.

A project is under consideration in Queensland for dealing with at least a proportion of the cane molasses annually wasted in that State. According to the *Australian Sugar Journal*, operations are in progress for the erection of a plant on the Brisbane river for the manufacture from molasses of acetate of lime. Few details are at present available, but it is known that the Brisbane University authorities have had a committee working for some time to solve the problem of the utilization of the molasses, and the present enterprise which is supposed to be the outcome is believed to be in the hands of the Commonwealth authorities.

An Italian decree has been published, which, for the duration of the war and for six months from the proclamation of peace, places under the control of the Government the production, working of, and trade in, sulphur.

An appeal is about to be made in connexion with a memorial to the late Sir WILLIAM RAMSAY, which will take the form of the institution of Research Fellowships, and the foundation of a Memorial Laboratory of Engineering Chemistry at University College, London. The committee desiderate a sum of £100,000, and already over £13,000 has been subscribed privately.

The Control of the Sugar Consumption in the United Kingdom.

New Regulations.

The decision of the Government to entrust the Local Authorities with the supervision of the distribution of the sugar supply has been quickly followed by the publication of the details of the proposed scheme.

The objects aimed at by LORD RHONDDA, the new Food Controller, are to conserve the sugar supply, to see that it is shared equally by rich and poor, and to keep prices down. To carry them out, local authorities are being instructed to form local food control committees who will be charged with the duty of seeing that the new regulations relating to the distribution and consumption of sugar are enforced within their district.

The main features of the scheme for the sugar supply are as follows :—

The retailing of sugar will after October 1st next be confined to persons or firms who have registered themselves as retailers of sugar and to no others. All applicants who were retailers of sugar in 1915 will be granted certificates of registration, while more recent dealers will be treated according to the merits of the case, regard being had solely to the needs of the public in the district.

Every householder will be entitled to apply not later than October 6th next for a sugar registration card from the local food office to cover all members of his household. His application will state the name and address of the registered retailer from whom he wishes to purchase his supplies of sugar, and when he receives his card will have to hand it over to the said retailer, who will keep the upper part of the card and sign and return to the owner the lower part. Thereafter the householder and the members of his household will become the registered customers of that retailer, add it will be the duty of the latter to see that his customer gets the amount of sugar weekly to which he is entitled. Failure to carry out this undertaking may lead in unreasonable cases to the withdrawal by the local food committee of the retailer's certificate of registration. But time is to be given till December 30th next for the scheme to come fully into operation before the regulations are enforced. After that date a retailer's supplies will be finally regulated so as to permit of his providing each of his regular customers with the weekly allowance of sugar for the time being authorized by the Food Controller. A customer will not be compelled to take his weekly allowance, but if he misses a week there will be no claim to a double allowance in the week following. Arrangements will of course be made for the transfer of registration in the case of permanent removal to another district; but the scheme as at present outlined does not appear to provide for the temporary movement of a family to another locality, say at holiday seasons. Efforts will be made to keep a check on the lists, so as to detect fraudulent attempts to get sugar in excess by means of dual addresses; the penalties of fraud are to be a heavy fine and imprisonment with hard labour.

Caterers' establishments will be regulated, and after November 4th next will not be allowed to obtain sugar except upon an authority issued by the local Food Control Committee. They will be rationed on the basis of the number of customers or meals supplied within a certain period, of which they have to supply particulars, and they will receive vouchers authorizing them to purchase a given quantity of sugar. Each caterer will be required to make a return every four weeks to the local food office showing the quantity of sugar he has received and used during that period.

Manufacturers will have their supplies of sugar regulated in accordance with any restrictions imposed on the use of sugar and will obtain their sugar on surrender of vouchers supplied to them by the local authority.

Notes on American Sugar Production.

Hawaii.

(From our American Correspondent)

With the exception of a labour shortage which at times has threatened to assume serious proportions, the Hawaiian sugar industry has enjoyed three prosperous and highly satisfactory seasons. While the 1915-16 crop was below those of the other two years, being approximately 10 per cent. short of what may be regarded as the normal output of the islands, the high prices that have prevailed since the beginning of the war have resulted in exceptional profits for the planters.

The total sugar crop of Hawaii, expressed in long tons, for each of the past three seasons, has been as follows:—

1914-15	576,400
1915-16	526,340
1916-17	574,000

The figures for the current crop are estimated, as grinding has not yet been fully completed, but, as the figure is based on the carefully compiled estimates of the Hawaiian Sugar Planters' Association and as the greater part of the season's production is now completed, the final figures are not likely to be more than a few hundred tons above or below the estimate. At the prices prevailing for 96° test sugar during the marketing period of the past three years the total value of these crops was over $200,000,000 or between $65,000,000 and $70,000,000 each year.

Out of this very handsome income the Hawaiian planters have been able to make very extensive improvements in their agricultural and milling equipment and the various sugar companies have increased their distribution of dividends to shareholders. Nearly all of these companies have increased their dividend rates or have declared special dividends from time to time.

One reason for the relatively fine showing that Hawaii has made during the past three years is that the planters of the territory were better prepared than other American sugar producers to take advantage of the widespread demand and high prices brought about by conditions attending the war. The Hawaiian industry has long enjoyed a reputation for exceptional efficiency both in the agricultural and in the milling branches of sugar making. Moreover, sugar is the one important crop of the islands and the only one that they can grow to advantage.

Consequently, when Congress in 1913 passed a tariff law which reduced the import duty on foreign sugar and decreed its free admission after May 1st, 1916, the Hawaiians did not follow the example of other sugar growing sections of the country by seeking to substitute other products for cane, in part at least. Having no other crop to which they could turn successfully they cut their costs of production to the lowest possible notch, eliminated waste by the adoption of improved machinery and methods and settled down to wait for better times. These were not long in coming, as the event proved, and when the sharp advance in prices occurred in August, 1914, certain Hawaiian cargoes that were on their way from Honolulu to New York around Cape Horn almost doubled in value *en route*.

The good results obtained through the systematic endeavour to increase efficiency are shown by a recent Governmental report based on data collected from the books of 52 plantations in the islands. This report gives the following average statistics of production for these plantations during 1914:—

Tons of cane per acre	43·92
,, sugar ,,	4·90
,, cane required to produce 1 ton of sugar	9·12
Lbs. of sugar per ton of cane	245·63

The cost of production in Hawaii is enhanced by the heavy fertilization required and by the necessity of irrigation on the great majority of plantations. Thus the cost of planting an acre of cane in Hawaii was $19.17 as compared with $4·24 in Cuba. Even with the much higher yield of cane the cost of planting per ton of cane amounted to 40 cents or exactly double the cost in Cuba. The average costs per acre of various agricultural operations were stated as follows:—

	Dollars.
Ploughing and planting	19.17
Cultivating	24.15
Irrigating	67.91
Fertilizing	40.37
Harvesting	36.03

The combined cost of all agricultural operations in Hawaii in the year of this investigation was $229.79 on plantations using irrigation, and $171.14 for those where irrigation was not employed, or an average of $214.23. With an average production per acre more than double that of Cuba, therefore, the cost of producing and shipping sugar was still considerably greater in Hawaii, being placed by this investigation at 2.70 cents per lb. as against 1.72 cents in Cuba.

This difference, curiously enough, is almost exactly balanced by the existing import duty of 1 cent a lb. on Cuba sugar which shows that, in 1914 at least, the Cuban and Hawaiian planters were virtually on an equality in competing for the American market. Since 1914, of course, the expense of production has greatly increased in both countries with the decided advance in the cost of labour and materials. Whether the relative advance has been the same it is impossible to determine except by an elaborate investigation. It is generally held in the sugar trade, however, that the cost of production in all sections contributing to this market has increased from 75 to 100 per cent. since the beginning of the war.

At the present time, the Hawaiian industry faces a most encouraging outlook for the immediate future. Through the two refineries located at San Francisco, which operate almost entirely on Hawaiian sugar, the product of the islands finds a ready market throughout the western half of the United States where it competes actively with the beet sugar produced in the Western States. About half the Hawaiian crop is still marketed through two Atlantic Coast refineries, being shipped overland from San Francisco by rail during the present scarcity of shipping.

New York, July 21st.

It was recently officially stated in Parliament that on the recommendation of the Board of Agriculture and the Development Commissioners, the Treasury have made a loan of £125,000 from the Development Fund to the British Beet Growers' Society for the purchase of the estate near Newark with a view to the establishment of the industry there as soon as circumstances permit. The loan is to bear interest at 5 per cent. per annum, to be secured upon the estate, and to be repayable within two years of the date of the advance.

Centrifugal, Crystallizer, and Pan Capacity in Raw Sugar-house Design as affected by the Purity of the Juice.

By NOËL DEERR.

The object of this contribution is to show the relation between purity of juices and centrifugal, crystallizer and pan capacity. The method of operation considered is that known as the two-massecuite system, conducted as follows:—A high grade massecuite is dropped from the pans at 75° polarization gravity purity[1]; on drying in the centrifugals this massecuite is divided into 96° test sugar and molasses of 45° purity; part of this molasses is returned to the high grade massecuite to maintain the purity of the latter at 75°; as the molasses accumulates it is removed in low grade strikes of 55° purity, boiled on a footing of the high grade massecuite left in the pan. After cooling in motion for periods up to 72 hours, this low grade massecuite is separated into a wet sugar and waste molasses of less than 30° purity. The wet sugar which results is mixed with the molasses of 45° purity and pumped to the receptacles holding the 75° purity massecuite, with which it is mixed and dried.

The formulae and equations for computing the resulting quantities of the various products are given below:—

1. *Total quantity of 75° purity massecuite.*—Let the total quantity of gravity solids[2] in the 75° purity massecuite be unity; let x be the quantity of gravity solids at p purity, required to give a strike of 75° purity when mixed with molasses of 45° purity. Then $p\,x + (1 - x)\,45 = 75$. If p be taken as 80°, x is found to be 0·857; that is to say, 85·7 per cent. of the gravity solids in the strike are derived from the syrup of 80° purity, and for each ton of gravity solids in the syrup there would be obtained $\frac{100}{85{\cdot}7} = 1{\cdot}167$ tons of gravity solids in the 75° purity massecuite.

2. *Quantity of 55° purity massecuite produced.*[3]—If s, j, m are the gravity purities of the raw sugar, the syrup and the low grade massecuite respectively, the quantity of sugar removed to obtain this massecuite per unit of sugar originally present is given by the expression $\frac{s\,(j - m)}{j\,(s - m)}$; then per 1 ton of gravity solids in the syrup, the low grade massecuite contains $\left\{1 - \frac{s\,(j - m)}{j\,(s - m)}\right\} \times \frac{j}{m}$ tons of gravity solids.

This expression very conveniently reduces to the very simple one of $\frac{s - j}{s - m}$, the gravity solids in the raw sugar removed being given by $\frac{j - m}{s - m}$. For example, if s is 97, j is 80, and m is 55, the value of $\frac{s - j}{s - m}$ is 0·405; that is to say, for every ton of gravity solids in the syrup, 0·405 ton is found in the low grade massecuite of 55° purity.

3. *Quantity of 75° purity massecuite treated in the centrifugals.*—Part of the 75° purity massecuite is retained in the pan as a footing upon which the 55° purity strike is boiled[4]; if x is the quantity of gravity solids in the 75° purity footing, then $75\,x + (1 - x)\,45 = 55$, whence $x = 0{\cdot}333$.

---

[1] Cf. DEERR. *I.S.J.*, 1915, 407-411.

[2] *Ibid.*

[3] In the development of these formulae no distinction is made between purities and polarization purities.

[4] Some operators prefer to discharge the pan completely and to grain on syrup for the 55° purity strike.

When the syrup is of 80° purity, there is found 0·405 ton of gravity solids per ton in the syrup; 0·333 of this is obtained from the 75° purity massecuite, of which at 80° purity in the syrup there is produced 1·167 ton; the quantity of 75° purity massecuite which goes direct to the centrifugals is then

$$1{\cdot}167 - (0{\cdot}333 \times 0{\cdot}405) = 1{\cdot}032.$$

In addition, however, there is the sugar obtained from the 55° purity massecuite, which, after being mixed with molasses, is dried along with the 75° purity massecuite. This material is taken as 40 per cent. of the massecuite, and hence with 80° purity syrup will amount to 0·405 × 0·40 ton gravity solids per original ton in the syrup. The total quantity of 75° purity massecuite to be dried is then

$$1{\cdot}032 + 0{\cdot}162 = 1{\cdot}194.$$

In the annexed table are collected results of calculations similar to the above for purities 75° to 90°. In column *1* are entered the purities; column *2* gives the total quantity of 75° purity massecuite made; in column *3* is found the quantity of the 55° purity massecuite; column *4* is 33·3 per cent. of column *3*, and gives the quantity of 75° purity massecuite retained as a footing in the pan; column *5* is 40 per cent. of column *3*, and gives the quantity of wet sugar mixed with the 75° purity massecuite; column *6* is *2* + *5* — *4*, and gives the quantity of 75° purity massecuite dried in the centrifugals. All these quantities refer to tons of gravity solids per ton in the original syrup.

1.	2.	3.	4.	5.	6.
75	1·000	0·524	0·175	0·210	1·035
76	1·033	0·500	0·167	0·200	1·066
77	1·067	0·477	0·159	0·191	1·099
78	1·100	0·453	0·151	0·181	1·131
79	1·133	0·429	0·143	0·172	1·162
80	1·167	0·405	0·135	0·162	1·194
81	1·200	0·382	0·127	0·153	1·226
82	1·233	0·358	0·119	0·143	1·257
83	1·267	0·334	0·111	0·134	1·290
84	1·300	0·310	0·103	0·124	1·321
85	1·333	0·286	0·095	0·114	1·352
86	1·367	0·262	0·087	0·105	1·385
87	1·400	0·239	0·079	0·096	1·417
88	1·433	0·215	0·071	0·086	1·448
89	1·467	0·191	0·064	0·076	1·480
90	1·500	0·167	0·056	0·067	1·512

Inspection of the result of these calculations shows the very great percentage increase in the quantity of the 55° purity massecuite which takes place as the purity falls. On the other hand, the quantity of 75° purity massecuite is affected in a reverse direction, but in a much less degree; actually the total quantity of massecuite produced does not vary much as a function of the purity, but since low grade massecuites require much more centrifugal capacity than do high grade massecuites, with lower purities the number of centrifugals required increases; and further, for every purity the distribution of the number of the centrifugals between high grade and low grade machines will be different.

These points may be best exemplified by passing to actual capacities. Observation in actual work has led the writer to take the following as the capacity of centrifugals under average conditions:—

On 75° purity massecuite one 42 in. × 24 in. machine will handle 80 cub. ft., or 7200 lbs. per hour, corresponding to 6800 lbs. of gravity solids, and to an output of 4000 lbs. 96° test sugar. With 36 in. × 18 in. machines he has found the capacity to be 40 cub. ft., or 3600 lbs. of massecuite per hour, corresponding to 3400 lbs. of gravity solids and to an output of 2000 lbs. 96° test sugar. On 55° purity massecuite, a 36 in. × 18 in. machine will only handle 10 cub. ft. or 900 lbs. per hour, corresponding to 850 lbs. of gravity solids. In terms of the 36 in. × 18 in. machine, then, the relative capacity as between 75° and 55° purity massecuite is as 4 : 1. At 75° purity in the syrup where one machine is required on the high grade massecuite, $4 \times 0{\cdot}524 = 2{\cdot}096$ machines will be required on low grades ; at the other end of the scale, at 90° purity, where one machine is required on high grades, $\frac{0{\cdot}167 \times 4}{1{\cdot}5} = 0{\cdot}447$ machine is required on low grades. It follows, then, that in the rational design of a sugar-house not only is the output of sugar required to be known, but also the limits between which the purity will vary, and the quantity of gravity solids which is to be treated ; in other words, it is not so much a question of the sugar turned out, but of the non-sugar which has to be strained through the wall of sugar in the machine.

Another factor which adds difficulty to the design is that the gravity solids in the juice and the purity vary from season to season, and from the beginning to the end of the season. The last variation in one way favours and in another troubles the designer, since low purities and low gravity solids, and high purities and high gravity solids generally occur together ; thus with the first combination the increased proportion of 55° purity massecuite may be counterbalanced by the less quantity of material ; but with the second combination, both factors tend to increase the quantity of 75° purity massecuite made. It may then frequently happen that at one period of the season more of either the high grade or low grade machines are installed than is necessary, and at another period the reverse is the case. To get over the difficulty some houses are designed so that some proportion of the machines may be used indifferently on both high and low grade massecuites.

To further bring out the points discussed above, an actual computation of the centrifugals required may be given. The installation is to treat the massecuite resulting from 100 tons juice per hour, the extreme compositions of the juice being 77° purity and 15 per cent. gravity solids up to 85° purity and 18 per cent. gravity solids. From the table above it follows :—

				Lbs.
77° purity.	Gravity solids per hour in	75° purity massecuite..	1 099 × ·15×100×2000 =	32,970
	,, ,,	55° ,, ,, ..	0·477 × ·15×100×2000 =	14,310
85° purity.	,, ,,	75° ,, ,, ..	1·352 × ·18×100×2000 =	49,672
	,, ,,	55° ,, ,, ..	0·286 × ·18×100×2000 =	10,296

Allowing 6800 lbs. gravity solids per hour on a 75° purity massecuite for a 42 in. × 24 in. machine, and 850 lbs. per hour on a 55° purity massecuite for a 36 in. × 18 in. machine, there will be required[1] :—

77° purity.—75° purity massecuite .. $\frac{32970}{6800} = 4{\cdot}8$ 42 in. × 24 in. machines.

55° ,, ,, .. $\frac{14310}{850} = 16{\cdot}9$ 36 in. × 18 in. ,,

85° purity.—75° ,, ,, .. $\frac{49672}{6800} = 7{\cdot}3$ 42 in. × 24 in. ,,

55° ,, ,, .. $\frac{10296}{850} = 12{\cdot}0$ 36 in. × 18 in. ,,

As the installation must allow for the maximum at the different conditions the design would resolve itself into eight 42 in. × 24 in. machines for high grade, and eighteen 36 in. × 18 in. machines for low grade, some multiple of three being used in the last case since one unit of labour can handle three machines.

---

[1] The 55° purity massecuite is treated as dried in 36 in. × 18 in. machines, since it is considered well established that machines larger than this are not adapted for drying low grade massecuites.

Alternatively a design might be offered comprising six 42 in. × 24 in. machines on high grade and twelve 36 in. × 18 in machines on low grade, with six 36 in. × 18in. machines arranged for use on either. This arrangement, while effecting a saving of two 42 in. × 24 in. machines, complicates the general design and arrangement of piping, and is not in the writer's opinion desirable.

It may finally be added that the above computations are equally applicable to the calculation of pan and crystallizer volume required, passage from tons of gravity solids to cubic feet being made by a constant multiplier which may be approximated at 23·5 cub. ft. per ton of gravity solids.

Superheated Steam in the Sugar Factory.

By FRANK COXON.

(1) To a great number of sugar engineers, the mention of superheated steam generally produces a concentration of hostile thoughts and reminiscences featuring scored-out cylinders, burnt-out packings, cracked fittings, and a general red-hot impression of such intensity as to completely annihilate all considerations of the use of superheaters in the sugar factory.

This would be quite excusable if it is proposed to instal superheaters designed and proportioned on the lines of those used in central electric generating stations, where their adoption is to yield more or less of advantages such as reduction in pipe-line bores, better vacuum through reduction in volume of steam, elimination of separators, compounding of cylinders equal in efficiency to triple expansion, turbine protection, etc., etc., but this is not so.

Superheaters have only one use in the sugar-house, and that is to boost up the temperature of the main steam lines so that only dry steam, yet quite permissible with a little superheat, reaches the engine cylinders and other consuming units. Every day brings forth evidence of the necessity for some means of reducing the appalling losses from general condensation, the various units contributing being too numerous to mention, and there can be no question of the satisfactory results obtained by using a small amount of superheat to reduce these troubles from wet steam so peculiar to this industry.

The advantages of superheat other than those obtained in running losses of this character need not be seriously considered in the case of the sugar factory, and superheating of the steam for evaporative work has proved so far of no special value. What is desired and necessary is dry steam at the entrance of the consuming vessels or units.

A moderate amount of superheat, say 50° to 100°, would have no appreciable effect chemically or mechanically, on any of the working parts, should it get through to such units, but would incidentally give a very much better quality of exhaust steam, and by delivering live steam from the boilers with superheat of this intensity would boost up the whole distributing and exhaust collecting system, to such an extent as to have a remarkable influence on the fuel consumption and steam capacity.

All central factory propositions are now designed to use a moderate amount of superheat, and many existing centrals are now installing superheaters, but it is the smaller factories that will find the necessity for a more serious consideration of the subject.

To prove on paper how a superheat of the intensity mentioned, 50° to 100°, is going to give any advantage to the working or steam capacity of the ordinary factory would be both futile and laborious; but, being so apparent, it is the lack of knowledge of a suitable superheater for sugar-house work that has been the deterring influence in its more universal adoption.

It might be pointed out here that in a general way the saving in steam consumption effected by superheating 100°, as compared with saturated steam, would be for:—

	Per cent.
Steam turbines	10
Triple expansion engines	12
Compound engines	14
Simple engines	18 and over.

Allowing that these as they do represent a salesman's figures, and are not guaranteed, it can be conjectured that a 7 to 10 per cent. saving could easily be effected in practical application.

The only superheater that will find favour must have the following points:—

(1) Be impossible to burn out.

(2) Require no attention such as flooding or draining.

(3) Have ability to give a fairly constant temperature under bagasse firing conditions.

(4) Possess efficiency in construction to give proper steam distribution against the hot walls of the tubular units.

(5) Must be fool-proof and take its place practically as a part of the steam line, a steam pipe.

(6) Possess accessibility on account of heavy dust troubles peculiar to bagasse burning.

The nearest approach to these ideal conditions can be reached by those types of superheaters known as "armoured," in which the seamless steel tube is protected either by cast-iron armouring in the shape of rings threaded on or by an outer steel protecting tube fitted.

(1) The protection afforded by the external covering is ample to prevent damage to the dry surface during the process of steam raising.

(2) There are times such as at steam raising when a superheater may be exposed to high temperatures and the necessity for guarding against damage by burning out has been provided for by fitting a flooding arrangement in which the superheater tubes are filled with water and made part of the evaporative surface of the boilers. To do this means many complications in valve fitting and manipulation.

Again, to admit water to the interior of a superheater invites the formation of scale with resulting loss of efficiency and stoppage of circulation, this being in no way of less importance than the disastrous results likely to occur if the water is allowed to be driven into the steam pipes through careless working of the valves.

A superheater fitted with protecting casings or armouring avoids the necessity for flooding devices or any form of connexion between the water space of the boiler and the superheater.

(3) The mass of metal in the tube and covering acts as a reservoir for heat which is imparted to the steam evenly and secures a constant temperature of steam in spite of fluctuations in the temperature of the hot gases so common in bagasse firing.

(4) The main tubes should have other tubes placed centrally inside and thus form an annular passage for the steam compelling it to cling closely to the heating surface and heat up in the most efficient manner.

(5) In complying with the conditions as above it becomes "fool-proof" and nothing more or less than a unit of the pipe line.

(6) Since the adoption will be, for cases under consideration, to H.R.T. boilers in the majority of cases, the usual setting of a multitubular lends itself admirably for the installation of a superheater.

It must be understood that for central sugar factory work having a very different kind of boiler room staff the conditions are somewhat altered, for under able supervision very few of the plain types of superheaters on the market other than those of the armoured type are unable to give full satisfaction, and the boiler maker's standard superheater in all those cases can be accepted with every confidence.

The urgent necessity for careful consideration of these efficiency points will be too apparent once normal conditions take place, for the keen competition from central factories will be very formidable in the future.

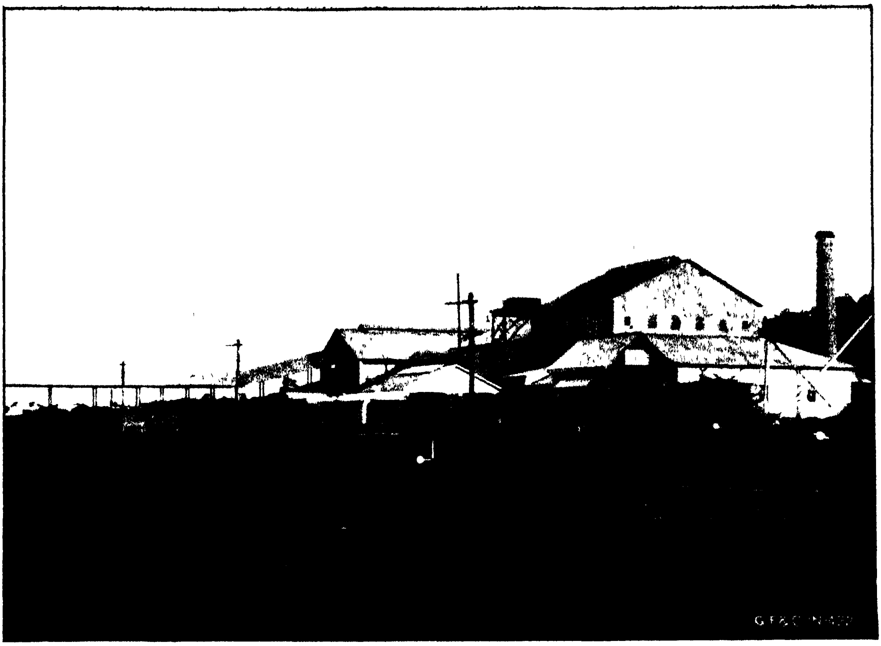
The "Babinda" and "South Johnstone" Centrals, Queensland.

Two British "Electrified" Sugar Factories.

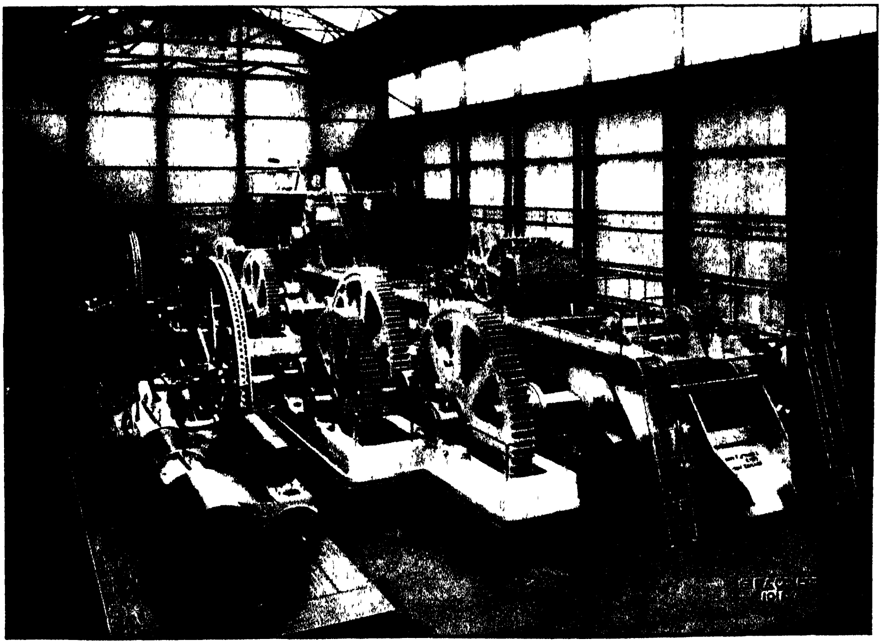
While a good deal has been published within the last two years in the American technical press on the "electrification" of numerous sugar factories, new or old, in Cuba, it is worth noting that at least two British sugar factories have within that period been fitted almost exclusively with electrical power plant (constructed in England by Messrs. GEORGE FLETCHER & Co., Ltd., of London and Derby); the only exceptions being in the power for the crushing rollers and the intermediate carriers, all of which are driven by two steam engines. One of these factories, the "Babinda," is situated in the north of Queensland, at the foot of the Bellenda Ker hills. The spot is about six miles from the sea coast and about 700 yards from the Babinda Creek. It is about 36 miles south of Cairns, with which port the factory is connected by rail. The other, the "South Johnstone" factory, is also situated in the north of Queensland, but a little further south than Babinda. It is about 13 miles from the sea coast, and about 200 yards from the south arm of the Johnstone river. The following description of the two factories and their equipment will be found of interest:—

Both Centrals are duplicates of one another in the main, each being designed to deal with 39 tons of cane per hour, containing an average of 8·5 per cent. fibre, and being estimated to produce 125 long tons of sugar per 24 hours, polarizing 96°. The factories are calculated to deal with 100,000 tons of cane per campaign. The "Babinda" factory has taken off two crops already, the second crop being unusually heavy consisting of a total of 155,000 tons. The equipment has, however, responded nobly to the demands which have been made upon it during the second crop, and the whole of the 155,000 tons has been crushed. Owing to the late delivery of some of the machinery, through the demands made upon the contractors for plant by the Government for munitions, the whole of the equipment for the "South Johnstone" mill could not be erected in time to commence crop work. In spite, however, of all the machinery not being available, this factory has crushed 55,000 tons of cane, and the plant will no doubt prove to be equal to the "Babinda" one in capacity when completed.

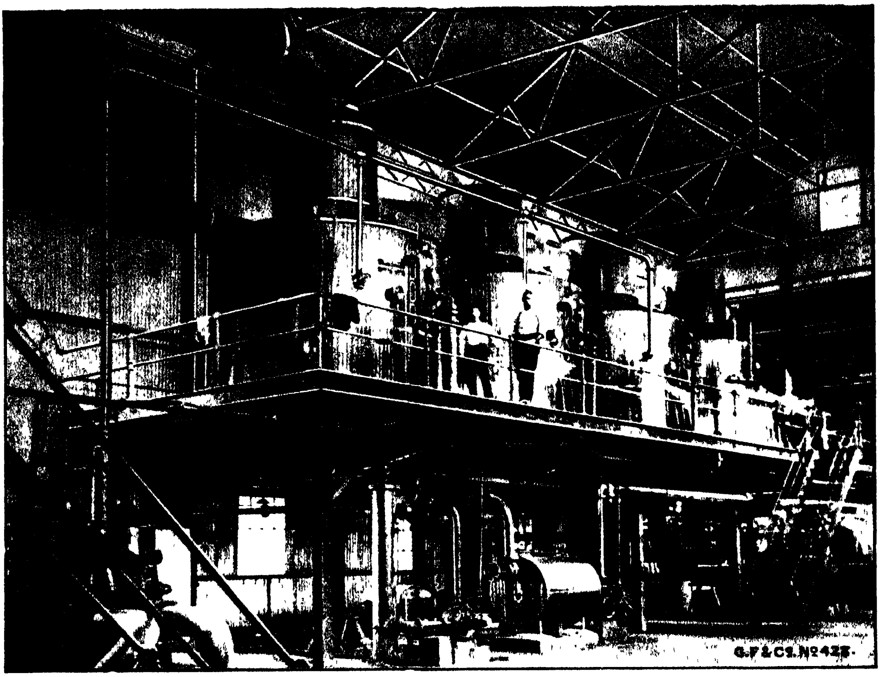
The canes arrive at the carrier, which is of all-steel construction, in Government trucks of 2-ton capacity, are hauled to convenient positions by 1-ton electric



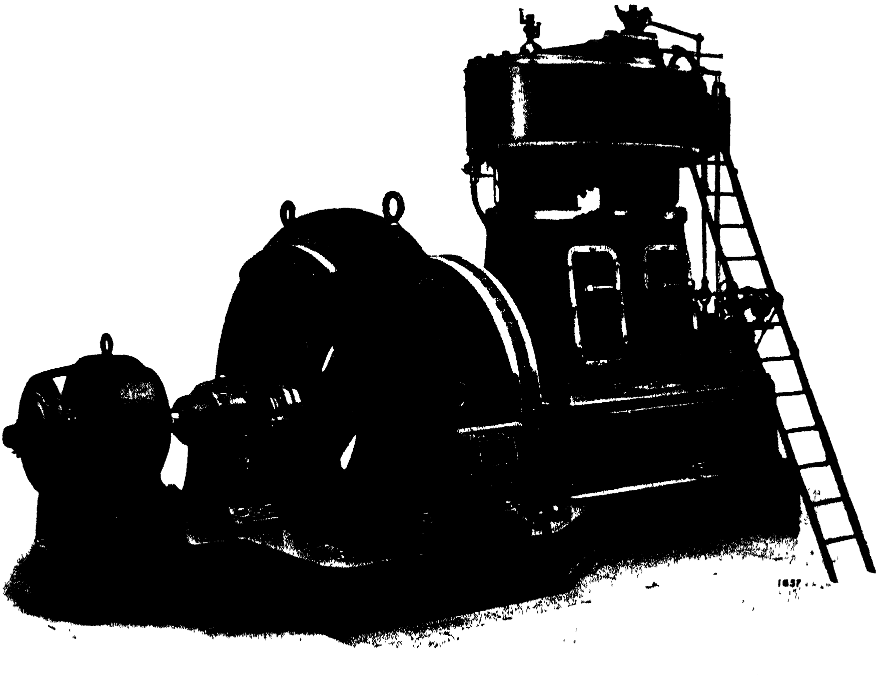
South Johnstone Sugar Mill, Queensland.



Milling Plant for the Babinda and South Johnstone Centrals.



Quadruple Effect supplied to Babinda and South Johnstone Centrals



Steam Driven Electric Generating Set, Babinda and South Johnstone Centrals.

capstans, and unloaded mechanically by two rake unloaders of the Davids' type. The cane carrier is provided with independent electric driving gear, so that the speed of the carrier can be readily varied in order to maintain an even feed to the crusher. The crushing plant consists of 14 rolls made up of a "Krajewski" having rolls 26 in. diam. × 66 in. long, and four mills 32 in. diam. × 66 in. long; and the plant is worked by two compound engines driving eight and six rollers respectively, and having steam cylinders 18 in. and 28 in. diam. × 42 in. stroke, taking steam at 160 lbs. pressure and exhausting to the main at 10 lbs. per sq. in.

The intermediate carrier between the first two mills is of the ordinary slat pattern, whilst those between the second and third mills are of special design. Between the second and third mills the bagasse is passed through a maceration bath. The carrier between the last two mills is of the rake type. In accordance with usual Australian practice, heavy maceration was adopted, the amount of water used representing 35 per cent. of the weight of normal juices.

The top rolls of all the Crushing Mills are fitted with hydraulic pressure regulating gear, a separate accumulator being provided for each mill, the loads on the various rolls being 330 tons, 370 tons, 400 tons, and 440 tons on the first, second, third, and fourth mills respectively.

The juices from each mill are kept separate at the Milling Station and run to cush-cush strainers of the usual brush-and-rubber-slat-chain type, the cush-cush being raised by two elevators in front of the first and second mills respectively. From the strainer tanks the juices are pumped and now mixed in three liming tanks fitted with stirrers where the mixed juice is treated and pumped through two superheaters of the high velocity type leaving at 220° F. in a specially formed separator to collect the flashed off vapour. Clarification is carried out on the continuous subsiding system, the clear juice flowing to a large effect storage tank from which it is pumped into the quadruple effect evaporator.

The evaporator is of the floating calandria type with brass tubes and steel plate calandrias, and has a heating surface of 15,000 sq. ft., the condensations flowing from one vessel to another, and are finally extracted by one main pump which sends the condensate to storage tanks for maceration purposes. The first vessel condensate is collected by a large receiver and automatically pumped to the boiler feed tank. The syrup is stored as usual in tanks on the pan platform which have a total capacity of 10,000 gallons, and from thence the syrup is drawn into the pans, there being three provided of the coil type, 10 ft. diam., each having 760 sq. ft. heating surface and a strike capacity of 22 tons of massecuite.[1]

Six crystallizers are interposed between the pans and centrifugals, each having 5000 gallons of storage space and each capable of holding a full strike of any pan plus 20 per cent. molasses. They are of the semi-open circular type, fitted with worm drive driven from one shaft, coupling all machines together.

Two batteries of electrically-driven centrifugals made by Messrs. WATSON, LAIDLAW & Co., Ltd., of Glasgow, are used, of eight units each, the machines having baskets 36 in. diam. A special electric current transformer is supplied for transforming the periodicity when a higher speed is necessary for the efficient cleansing of the sugar should bad juices be worked and yield sticky, hard to cure, crystals. Large strike receivers are used to feed the centrifugals placed over these machines and receive the charge direct from the crystallizers. The usual elevators and conveyors are fitted delivering the first sugar to a storage and bagging hopper with bag filling and weighing machine fitted, and thence passing to bag sewing machines. The bag filling and weighing machines were supplied by Messrs. RICHARD SIMON & SONS, Ltd., Nottingham, while the Sackfilling and Sewing Machine Syndicate, Ltd., of Mark Lane, London, were responsible for the bag sewing machines. Portable sack elevators are used for storing, the molasses sugars being melted up and returned to the pans for seeding purposes.

---

[1] In the "Babinda" factory one coil pan and two Express patent pans were provided, but as the Express pans did not give entire satisfaction, it was decided to provide all pans of the coil type in the "South Johnstone" factory.

The pumps for transferring the juice from the crushing plant to the liming tanks are Rees Roturbo centrifugal ones, supplied by the Rees Roturbo Company of Wolverhampton. In addition the same firm supplied separate condensing equipments for the quadruple and pans, consisting of two units of the Rees Roturbo rotary condensers, each capable of handling 25,000 lbs. of vapour per hour and driven by direct coupled electric motors. This form of condenser eliminates the use of the usual condenser body and barometric column, and in the case of a low level condenser eliminates the extraction pump, the whole of the work, i.e., condensing air and water extractions, being done by one rotor. These condensers are the first of the kind to work in Australia and the results have been satisfactory, a high vacuum being steadily maintained. The cooling water for the condensers is obtained from the neighbouring river and is pumped through a 20 in. delivery pipe of about 900 yards by a Rees Roturbo electrically driven centrifugal pump situated on the river bank. In fact, the whole of the pumping outfit for juice, syrup, remelted sugar, and water, comprising in all 15 sets, was sub-contracted to the Rees Roturbo Company Ltd., the pumps being of their well-known self-regulating pattern.

The power plant consists of three Bellis & Morcom compound engines driving three Crompton alternators generating 3-phase current at 415 volts, 50 cycles, each of 200 k.w. output. The switch-board is complete, comprising three main alternator panels, one voltage regulator panel, and 6-feeder panels, a rotary synchronoscope, a clock, and 7-day chart-recording watt meters, being amongst other special fittings. Lighting is carried out by both direct static transformers and an auxiliary lighting set. An overhead travelling crane and gantry, also ventilation fan, complete the equipment of the power-house.

Water service is laid throughout the factory including special fire connexions, and supplied from a high level tank fed by a centrifugal pump. The boilers are of the Babcock & Wilcox water-tube type in four units, each having 4780 sq. ft. H.S. and fitted with Foster's patent armoured superheaters, the working pressure being 160 lbs. per sq. in. Two feed pumps are provided, one of the Weir's steam driven marine pattern and one Rees Roturbo multi-stage turbine type electrically driven. The furnaces are of the step-grate pattern with mechanical draft fed by mechanical feeders of the rotary type and chain driven from electric motors, suitable clutches being fitted to each feeder. The bagasse feeder carrier is arranged on the surplus system, storing a surplus on a large platform over the furnaces which can be sent as desired into the main shoots leading to the rotary feeders.

The scums and juice bottoms are dealt with in the ordinary way in scum blow-ups and filter-presses of the side feed plate and frame type. A notable feature is the lagging of all hot liquor tanks, a practice now becoming universal.

Steel frame buildings house the machinery with corrugated sheeting covering and glass window lighting. As regards the electrical equipment in general, there are approximately 60 electric motors about the factory, and the efficiency in electric drive can clearly be seen when it is remembered that in a steam-driven factory the majority of these would be steam cylinders. Complete workshops, iron and general stores are arranged adjacent to the main building forming a lean-to, divided up as required, an overhead travelling crane and oil engine making the workshop equipment complete.

In conclusion, it may be said that these factories are thoroughly representative of the best British practice, and their success at the outset reflects no small credit on Messrs. GEORGE FLETCHER & Co., Ltd., of London and Derby, the contractors for the supply of the machinery and for the erection of the plant on the sites in Queensland.

The American Cane Sugar Industry.

An Official Investigation.

A voluminous Report has recently been issued by the United States Department of Commerce on certain investigations into the cost of production of cane sugar in Hawaii, Porto Rico, Louisiana and Cuba, carried out within the last two years by the Bureau of Foreign and Domestic Commerce at the instigation of Congress.

These four regions supplied, in the fiscal year 1914, 82 per cent. of all the sugar used within the United States; Louisiana provided 5 per cent., Porto Rico 7 per cent., Hawaii 12 per cent., and Cuba no less than 56 per cent.; and it was desired to prepare for official and public use as complete a picture of the sugar production as possible in such perspective and detail that all concerned would be fully informed regarding the industry in all its branches. The tariff issue is not discussed in the Report; but in view of the conspicuous position the sugar question holds in tariff discussions, the comparative results now disclosed furnish, in the view of the Commission, basic facts that are bound to receive consideration in determining appropriate rates of duty.

Opinion in American sugar circles indeed claims the Report as an effective answer to the assertion that the domestic cane industry does not need the protection afforded by the present Customs duty in periods of low prices. The removal or appreciable reduction of the present tariff rate, which almost exactly equals the difference between the cost of Hawaiian and of Cuban sugar, would make it impossible for Hawaii to compete under normal conditions in the only market open to her. And what applies to Hawaii is even more imperative in the case of Louisiana and Porto Rico, where the manufacturing costs are still higher.

The chief comparisons established as a result of the investigation are briefly summarized by the Commission as follows:—[1]

"Natural conditions are most favourable in Cuba. There is no scarcity of fertile land suited to sugar cane; there is abundant rainfall; there is sufficient population to supply the labour needed, without the pressure of population upon land that leads to high land values and tends toward relatively small holdings. In Hawaii conditions are very different. Land suited for sugar cane is limited in area and high in price; deficient rainfall requires on most of the plantations expensive systems of irrigation; the use of fertilizers is necessary; and labourers from other countries must be induced to settle in the islands. Yet, by science and co-operation, these difficulties have been largely overcome; nowhere is the cultivation of sugar cane more intensively and successfully conducted; nowhere is more efficient machinery employed; nowhere are accounts more carefully kept; and nowhere is the industry, as a whole, more skilfully directed.

---

[1] We hope in succeeding issues to give a more detailed summary of the chief features of this Report, treating each region separately.—Ed., *I.S.J.*

"These contrasting conditions are clearly reflected in the costs of production shown in this report. The acre cost of cane growing is high in Hawaii—four times as high as in Cuba, three times as high as in Louisiana, and twice as high as in Porto Rico. But intensive cultivation in Hawaii, largely with irrigation, gives yields twice as large as in any other regions considered. A high sugar content in the cane, and more effective machinery, combined with low factory expense, tend further to reduce the cost of production in Hawaii. As a result, sugar is produced in Hawaii at a lower cost per ton than in Louisiana, or even Porto Rico, but not at so low a cost as in Cuba. The difference between the cost in Hawaii and Cuba, however, is less than the import duty levied on Cuban sugar.[1]

"Porto Rico, in spite of its tropical climate and its proximity to Cuba, is under a serious handicap in sugar production. It contains comparatively little land suited to sugar cane, and much of the land is split up into small holdings. Irrigation is necessary in many parts of the island. Notwithstanding the low wages paid to field and factory hands, the labour cost is high.

"In Louisiana, on the other hand, the climate is the most serious drawback. Land is fertile and well watered. The occurrence of frost, however, limits the growing season to nine months. The cane therefore never fully matures. The yield of cane per acre is accordingly small, and the sugar content of the cane considerably lower than in the other regions treated in this report. Effective work by the State experiment stations has failed to overcome these disadvantages. The short grinding season presents special difficulties in factory operations."

Manurial Experiments with Sugar Cane in the Leeward Islands.[2]

The performance of extensive manurial trials has, together with experiments with varieties, constituted an integral part of the sugar cane experiments conducted in the Leeward Islands since their first inception in 1891—a period of 25 years. During the earlier part of this time the trials were confined to the Government Experiment Station at Skerretts, Antigua, but in the year 1889 they were extended to include trials carried out on fields situated on estates in Antigua and St. Kitts, in the same manner as the experimental comparisons with cane varieties, thereby affording as near an approach as possible to agricultural conditions in actual practice.

At the outset of these experiments no precise information was available concerning the manurial requirements of sugar cane when grown under the conditions obtaining in the Leeward Islands. Actual planting practice was founded on the experience of cane growers obtained over a long period of time, but lacked the definite authority conveyed by a systematic investigation of the circumstances of the case.

The result of 25 years' continuous experimentation along carefully defined lines has been definitely to set at rest many queries and speculations.

The presentation of data obtained in this way year after year must inevitably evince a considerable degree of sameness, but it is to be remembered that work of this description necessarily occupies a considerable length of time, since it is only by numerous repetitions of each experiment that reliable results can be achieved.

---

[1] The *difference* is given as 0·978 cents per lb.; the *duty* as 1·0048 cents.

[2] Extracted from "Sugar Cane Experiments in the Leeward Islands: Report on Experiments conducted in Antigua and St Kitts in the Season 1915-16," compiled by the Imperial Department of Agriculture for the West Indies.

At this present juncture definite answers have been returned to many of the most obvious queries; at the same time certain other questions have arisen as the outcome of former lines of work, and to the solution of these, future activities will require to be directed. Below will be found a summary of the conclusions already arrived at, together with a concise indication of those lines requiring further elucidation.

RESULTS ACHIEVED IN MANURIAL EXPERIMENTS.

At the time when manurial experiments with sugar cane were first commenced in the Leeward Islands, it was commonly thought that the dressings of pen manure, which were, according to common practice, applied to fields of plant canes, might profitably be capable of being supplemented by appropriate dressings of artificial manure. Colour was lent to this view by the results obtained in similar trials in Barbados, and accordingly, after a number of preliminary experiments had been conducted at Skerretts between the year 1891 and 1897, a series of trials was laid out with a view. to ascertaining whether addition of artificial manures to fields of plant canes which had already received a dressing of pen manure at the rate stated, could with advantage be made.

This original series of experiments with plant canes comprised 33 different experiments each in duplicate, conducted on fields situated on estates in Antigua and St. Kitts; they were inaugurated in 1899, and at the end of the year 1907 it was found possible to return a definite answer to the query involved, namely, that if a dressing of pen manure at the rate of 20 tons per acre was applied to fields of plant canes, supplementary dressings of either pen manure or combinations of the ordinary artificial manures did not produce increases of yield which were remunerative. This result supplied an answer to a very important query, and has been accepted as a reliable guide in practice by planters.

Careful consideration of the results and of the factors attending the growth of the cane in the Leeward Islands showed that the limiting factor involved in the production of the cane crop was the water supply available for growth.

Under the conditions obtaining throughout the cane-growing area, the crop is entirely dependent on the rain which falls during the season for the necessary water to maintain its growth, with the reservation that in certain favoured districts the rainfall might be supplemented by seepage water from higher levels. Consideration of the water supply available in this way in relation to the transpiration ratio of the cane plant rendered it clear that the limiting factor of the water supply inhibited the absorption of more than a certain amount of plant food, and that in consequence, manuring beyond a certain limit was of necessity ineffectual under these conditions. It appeared that under average circumstances in Antigua and St. Kitts, a dressing conveying about 20 tons of good pen manure per acre provided a store of plant food sufficient for the requirement of a good crop of plant canes such as experience denotes as capable of being produced under the conditions in question, together with a crop of first ratoons and possibly second ratoons, provided that, as is the current practice throughout the colony, the trash is returned to the land after each crop has been reaped. If, however, the available water supply could be increased and regulated by supplemental irrigation, the position would be altered.

During the progress of these experiments collateral work in the laboratory and the field demonstrated that, as has also been found by investigators in other parts of the tropical world, on the maintenance of an adequate supply of organic matter in the soil the retention of a high degree of fertility is largely dependent. It was shown that at the high temperature prevalent in the soils of West Indian islands, the decay of organic matter proceeds with extreme rapidity when compared with conditions governing agricultural operations in more temperate climates. On the maintenance of an adequate supply of soil organic matter depends not only the existence of that particular mechanical condition of the soil usually referred to as tilth, but also the maintenance of the various biological activities of the soil in a suitable condition. In consequence it appears that the regular supply of organic manure must be regarded as an essential if fertility is to be maintained, and that the most satisfactory manner of applying this consists in dressings of well-rotted pen manure at the rate of about 20 tons per acre.

In any agricultural community, especially if conditions are not at times very flourishing, the production of sufficient cattle pen manure to enable a dressing to be given to every field of plant cane on an estate may sometimes prove a matter of difficulty, involving as it does the investment of capital in a large number of stock, together with the attendant anxiety and expenditure incident to their maintenance. In the course of these reports, therefore, attention has been directed to the most economical methods of preparing and conserving pen manure, and the manner in which other organic material may be utilized to supplement existing supplies.

Of recent years, with a view to obtaining definite and practical information on this point, a further series of trials with plant canes has been inaugurated with the object of ascertaining what combination of artificial manures could be most satisfactorily substituted as a temporary expedient for a dressing of pen manure, in the hope that such knowledge would assist in working out a definite system of manuring sugar estates, whereby every field of plant cane on an estate could receive some manurial treatment each year, while the available organic manure by systematic handling in this way could be made to go as far as possible and render the most efficient service.

In relation to ratoon canes, continuous manurial experimentation over a period of 14 years showed clearly that early applications of quick acting nitrogenous manures such as nitrate of soda, sulphate of ammonia, and nitrate of lime, conveying doses of nitrogen at the rate of 40 lb. per acre, were of considerable benefit under average conditions. Investigation has shown that such dressings must not be regarded so much as a manuring but rather as plant stimulants, which enable the cane plant to resume its normal functions after the reaping of the plant cane crop, and to avail itself of existing reserves of plant food in the soil.

The experiments showed that the effect of such dressings was best seen in seasons of normal rainfall, or when precipitation is above the average; in dry years the applications were not as a rule profitable. Furthermore, in accordance with the law of diminishing return, a limiting value for the price of sugar also existed in relation to the profitable nature or otherwise of the application.

A number of interesting minor points have further been elicited in relation to these experiments. Chief amongst these may be cited the very remarkable result obtained in the application of phosphatic manures, which, as the mean of very many experiments both on plants and ratoons, shows that under Leeward Islands conditions practically no increase of yield follows the application of phosphatic manures. It would seem that the soils of these islands are normally supplied with sufficient reserves of phosphoric acid to meet the requirements of the cane crop; but the further elucidation of this point would probably be worthy of careful study.

The effect of large and small dressings of lime has also been studied from time to time, and as the upshot of these investigations, it would appear that under the ordinary range of conditions, small dressings of lime, applied with the object of neutralizing possible acidity and promoting nitrification, are of but little benefit; on the other hand, heavy dressings of calcium carbonate on clay lands have been shown to be markedly beneficial.

It has also been shown that applications of artificial manures to plant canes and first ratoons may exert an appreciable residual effect on the returns experienced in the succeeding crops of first ratoons and second ratoons respectively.

In the earlier years of the experiments it was customary to crush the canes obtained from each manurial plot and analyse the juice, expressing the results in terms of sucrose, lb. per acre, but a survey of the results obtained clearly showed that, under the Leeward Islands conditions, the action of the manures had little or no effect on the composition of the juice of the canes. In consequence, in 1904 the analysis of the juices from canes reaped in the manurial experiments was abandoned, and since then the results have been expressed in terms of tons of cane per acre.

Attention has been directed to the effect of intertillage on ratoon canes after reaping as plants, and experience has shown that, provided that such intertillage is performed in the moderately early stages of growth, beneficial results will accrue therefrom.

A further point which has received attention deals with the application of exhausted molasses to cane lands with a view to increasing the activity of soil organisms of Azotobacter type, as the result of the addition of saccharine matter to the soil. The results indicate that such applications are of little or no value in the case of ratoon canes; in relation to plant canes, it seems possible that increases of a larger character may be encountered. In any case, however, the growing importance of waste molasses as a source of industrial alcohol renders it improbable that this method of employment will find any markedly profitable application in the future.

At this present time the manurial investigations in progress mainly concern themselves with practical investigations relating to the manuring of plant canes. It is contemplated in the immediate future so to modify the method of experimentation as to eliminate a number of experiments on points which have been fairly clearly elucidated, and by concentrating on the essential features which have emerged, to secure by means of an increased number of repetitions of each experiment in each season, a more rapid accumulation of results.

Finally, the question of the effect of the continued application on one particular form of manurial treatment of individual soils is receiving consideration, and in St. Kitts a permanent manurial experiment station has recently been laid down on which it is hoped, by continued repetition of each experiment over a long term of years, to arrive at definite conclusions in this respect.

The Royal Commission for Sugar Supply are understood to have bought a considerable quantity of the new Java crop, the bulk of which will be direct consumption quality. Much depends on their ability to get this sugar shipped safely to this country; but it may be assumed that the necessary arrangements will be made.

M. SAILLARD, director of the Laboratory of the Syndicat des Fabricants de Sucre de France, has been commissioned by the Minister for Ravitaillement to undertake the task of visiting the sugar factories in the zones recently freed from enemy occupation and ascertain how soon it will be possible to restore them to full working order. His report when ready will be submitted to the Minister.

Experimental Work in Porto Rico.

Report for the Year 1915-16.

GENERAL.

The report of the Director of the Rio Piedras Experiment Station (Mr. W. V. TOWER) for the year, ending June, 1916, states that the period under review was a very satisfactory one for most of the agriculturists of Porto Rico. Conditions had been such as to make for very high prices for sugar, with the result that there was a great extension of the area planted to cane. This had, however, one bad result in that the extensive plantings made impossible any proper cultivation methods,[1] and it subsequently became apparent that in many cases the increase in area would be offset by a decrease in yield. Intensive methods are very necessary to obtain satisfactory crops from the average Porto Rican soil.

Molasses and alcohol, by-products of sugar manufacture, have shared in the prevailing high prices; larger quantities than in normal years have been produced and in large part exported to foreign countries. And, as a still further by-product, one concern is making a fertilizer ingredient high in potash from the molasses residue left after distillation.

The year has been a very profitable one to the Experiment Station, and progress has been made along all lines of research. Some 50 acres were under cane, and about 4433 seedling canes were kept under observation. Besides a quantity of experimentally-grown cane which was sold, the Station produced 300 tons of cane seed for free distribution.

A very important phase of the Station staff's activities consisted of trips of inspection to practically all the centrals and many of the colonos, where studies were made of field conditions, varieties grown, cultivation practices, fungus diseases, and insect pests. Improved agricultural methods were advocated and control measures recommended for the insects and diseases.

CANE BREEDING.

Under the supervision of the plant breeder, Mr. H. B. COWGILL, work has been continued on the projects in cane plant breeding, and has received the greatest attention, especially with a view of getting hybrid canes; here considerable success has been attained, the cross-pollination of certain varieties so as to get canes of known parentage having resulted in the production of some good strong seedlings. In the course of experiments it became evident that certain varieties when used as parents would produce very much better seedlings than others, so as the male or pollinating parent has as much effect on the progeny as the female, steps were taken to keep the pollen parent under control. To quote Mr. COWGILL, "for this purpose a method was given a trial which aimed to exclude all foreign pollen from the stigmas of the female parent cane. It consisted of bringing together in an enclosure, or bag, of cloth the tassels of the two varieties it was intended to cross. On account of the nature of growth of the cane it was necessary to support the bag in a vertical position, and to insure that it remained extended, in order that the fragile tassels within be not broken. This was done by securing a wire hoop at the upper and lower end of the bag and supporting the whole by means of a bamboo pole, with cross-bar, planted firmly in the ground. The tassels had to be tied in position within the bag. Besides insuring greater purity of the pollen, this method had the additional advantage that it enabled one to utilize varieties not growing in close proximity. The pollinating tassel can be cut from the cane and carried to the variety it is desired to use as a female parent. It should be cut with a long stalk or stem, the end of which should be placed in a bamboo joint partly filled with water, so that it may be kept alive for one or more days. It was usually necessary to renew the pollinating tassels two or three times. By the method above described about 1000 seedlings were produced in the past year, one tassel alone yielding over 1000 seedlings. The varieties used were Crystalina, as female parent, and Demerara 109, as the pollinating parent. The former is one of the best of the older varieties of cane, while the latter is a vigorous seedling variety, which has a good deal of disease-resistance. The fact that the Crystalina cane is almost completely pollen-sterile was an advantage, for otherwise the flowers would have been, to a large extent, self-pollinated, and cross-pollination practically prevented. There is still some possibility that some of the young canes resulted from self-pollination of the mother variety, but the extent to which this could have occurrėd would be sufficient to produce only a very few seedlings."

---

[1] In one instance observed, a *colono's* field had not been ploughed even once, the cane having been planted in shallow holes scraped out of very hard soil that could only with difficulty be loosened with a knife.

Besides this improved method of cross-pollination, there were others where no attempt was made to control the pollination. Thus Otaheite was crossed with B.347 and produced canes fairly uniform in appearance which showed in many instances distinct resemblances to one or both of the parent varieties. Again, Otaheite was crossed with B.3412, employing a slightly different method, which consisted in tying in position single tassels of the two varieties; here there was considerable resemblance to both parents, but it was strongest for the male. In colour, habit and character of buds the seedlings were more like B.3412, while in size of stalk and number of stalks per stool they resembled more closely Otaheite, the female parent. Finally a cross of Crystalina with D.109 (male), performed similarly to the test just mentioned, gave seedlings which resembled the male parent strongly, especially as to colour and shape of buds.

On the whole, the results of the cross-pollination work were very encouraging and there now seems to be no reason to doubt but that it can be successfully performed and hybrid canes be produced in sufficiently large numbers.

The work of supplying the sugar estates with seedling canes of foreign variety tested on experimental plots of the station has continued, and, as mentioned above, over 300 tons was distributed. It has been shown that while these varieties differ considerably in their characteristics and requirements they are in general more vigorous and healthy than the local varieties. Amongst them was B.208, the demand for which was greater than the supply. Its popularity was due to the fact that it yields a juice of higher sucrose content than other canes, but since it suffers badly in case of drought, lack of fertility, or poor cultivation, it will, in the opinion of Mr. COWGILL, probably be a failure unless favourable conditions can be supplied to it. Other varieties supplied which deserve special mention, owing to their comparative success, were D.117, a general purpose cane, B.3412, Seely Seėdling, and D.109. In variety tests undertaken by the Station, the following Barbados canes gave good results: B.7245, B.3405, and B.1809.

Fertilizer experiments so far conducted have established that in general the cane responds best to fertilizers containing a relatively high percentage of available nitrogen, and that phosphoric acid is usually second in importance, while potash is usually least essential. But in some cases, especially with new soils, there is enough of the fertilizer elements in available form present in the soil, so that no increase in yield is obtained by using fertilizers, or else the increase is too small to be profitable. Information on these points can be obtained with most certainty by conducting carefully-planned plot experiments.

CANE DISEASES.

During the year under review heavy loss from cane diseases was experienced in Porto Rico; it was the result of an accumulation of disease due to a combination of climatic and cultural conditions, rather than to any epidemic outbreak. It was, however, serious enough to give rise to some apprehension, and early steps were taken by the Station staff to advocate remedial measures. Most of the fields attacked belonged to small owners or "colonos."

Root disease giving rise to *Odontia Sp.* was very common among the infected fields; there was also found fungus disease like *Colletotrichum falcatum*, *Melanconium sacchari*, *Diplodia cacaoicola*, and others. No certain trace of *Marasmius sacchari* was, however, found. The principal causes for the prevalence of disease were three-fold: unfavourable weather conditions, there having been a sustained drought, which undermined the resistance of the canes; unsatisfactory cultivation of fields pressed into service for increased acreage of cane, no adequate ploughing or subsequent weeding and cultivation being in many instances given; and finally too great a dependence on old types of cane which had apparently degenerated. This last point was clear from the fact that the most susceptible canes to disease were the Otaheite (locally known as *blanca*) and the Cavangerie or *rayada*.

Various measures of control are advocated by the Experiment Station to suit Porto Rican conditions. The proper preparation of the land before planting, especially if it was previously pasture, is insisted on; the substitution of new and improved varieties which are more disease-resistant and the planting of clean healthy seed in disease-free soil is urged on the attention of planters. As regards methods of cultivation, stripping and trashing, though in theory they are of assistance in control, are condemned by the Station authorities as giving rise to an actual falling off in yield, while they would not pay in practice for the money expended. The burning of the trash is also condemned as tending to destroy useful insect parasites and deprive the soil of valuable humus, while it fails to get at the bulk of the root disease which is below the ground; and moreover many leaf diseases are not checked in the slightest degree by burning.

ENTOMOLOGY.

The work of the entomological department under the supervision of Mr. G. N. WOLCOTT has included the inspection of all plants, seeds, and nursery stock brought to Porto Rico, and the enforcement of quarantine against noxious insects and plant diseases from the United States and other countries; the continuation of white grub[1] investigations; and the making of observations on the abundance of *Diatraea saccharalis*, the moth stalk-borer of sugar cane, in all parts of the island where cane is grown. The *D. saccharalis* was more abundant during the year under review; and it was the almost universal experience that cane planted on new land was more heavily infested with the borer than that on land that was in cultivation the previous year. Hence the great extension of land in sugar is probably responsible for a large part of the higher infestation.

Mr. Wolcott's conclusion is that the only cheap and practical measures of control of this borer are (1) not to burn trash in fields to be ratooned; (2) to select seed in the field where it is cut and to destroy immediately any borer-infested seed that is discarded in the field when planting.

The Paris green-flour mixture which has been so successfully used in controlling the changa in tobacco fields has also been tried out in canefields and given 100 per cent. efficiency. This mixture consists of 3 per cent. Paris green added to 97 per cent. of a flour high in gluten, and is dusted round the plants in the fields by means of cheesecloth bags.

---

[1] The larvae of all injurious *Scarabaeid* beetles are popularly known as "white grubs."

The Increase of the Coefficient of Purity caused by Clarification.

By H. PELLET.

I have read the letter from Mr. SÖRENSEN in the June issue of the *International Sugar Journal*,[1] in which he says that from a mixed juice of 83·5° purity he obtained a clarified juice of 86·1° purity by adding only milk-of-lime to neutrality and heating to 108° C. This result is interesting, but to make it more convincing completer analyses of the juices should have been given, so as to observe, for example, the behaviour of the reducing sugars before and after heating to the temperature stated.

It would also have been desirable to know whether the analyses of the juices had been effected before passing them through a fine filter-cloth in order to retain all matter in suspension, since clarification comprises both the physical and the chemical effects.

Thus it has been demonstrated that if cane juice be passed through a close filter-cloth quite a large quantity of fine bagasse is retained, and further that if this juice be passed several times through the deposit held by the cloth, a fairly large quantity of soil (of which there is always more or less introduced with the stalks) may also be retained. Now the analyses of two juices, one unfiltered and the other filtered, do not give the same purity, and the difference will vary with the amount of dirt retained.

Moreover, the action of the lime is more or less efficient. According to what the author has been able to observe during the past 22 years, and from the results obtained in Java factories in which control is seriously carried out, it is rare to find defecation bringing about no real increase of the purity value, although sometimes, even after liming and sulphiting, one may have juices that filter more or less well, and that are more or less well decolorized, yet have a purity 0·2° to 0·5° *lower* than the raw juice treated.

It should be admitted that with very impure juices liming and heating must bring about an appreciable purification in consequence of the large quantity of matter precipitated. For example, in the Madjenang factory in Java during the 1916 campaign, when the cane had only 7·39 per cent. of sugar, the mixed juice had a purity of 68·4°, which rose to 70·3° after clarification, and became 69·5° in the syrup.

During the same campaign in Java 72 factories operating simple defecation gave the following figures:—

	Degrees.
Purity of the mixed juice	84·1
,, ,, clarified juice	85·9
Difference	1·8

But this increase of purity included both physical and chemical clarification, which latter only is here interesting for the deduction of the real effect. As to sulphi-defecation, for 53 factories the returns were:—

	Degrees.
Purity of the mixed juice	84·5
,, ,, clarified juice	85·5
,, ,, syrup	87·9

---

[1] Page 260.

And here the same observation may be made as above. Lastly, for the 20 *sucreries* using the carbonatation process, the values obtained were :—

	Degrees.
Purity of the mixed juice	85·4
,, ,, carbonatated juice	88·1
Difference	2·7
Purity of the syrup	88·8

It is quite natural to observe that carbonatation increases the purity of the juice by 2·7° (including that brought about by physical clarification); but it would seem difficult to admit a rise of 2·6° for a juice treated solely by simple defecation and heated to 108° C.

There is a point, rather a particular one, to which the attention of sugar factory chemists should be brought, and this is the rapidity with which the mixed juice deteriorates, while clarified juice limed and heated and perhaps superheated keeps much better.

It may thus happen on keeping some mixed juice the same length of time as some clarified juice before carrying out the analysis that the former may become a little changed, though the latter remains unaltered. Then on comparing the purity, a value is calculated which is not exact, on account of the deterioration of the mixed juice. Even with the addition of certain preservative substances, one cannot be certain of preventing the alteration of the juice owing to the transformation of the sucrose into reducing sugars by the influence of invertase which is contained in all cane juices and decomposes the sucrose quite rapidly even in the presence of chloroform, salicylic acid, thymol, formaldehyde, etc.

It is for this reason that in analysing juice before and after clarification it is interesting to determine the reducing sugars (per cent. of the sucrose); for it is quite evident that by simple defecation using lime in a neutral liquid the reducing sugars are not destroyed. After taking the samples in the most convenient manner, it should be found that the mixed juice has the same content in reducing sugars (per cent. of the sucrose) as that clarified by simple defecation or by sulphi-defecation. When using carbonatation, on the other hand, the reducing sugars may diminish 10–40 per cent. according to the conditions under which one may be operating the process.

It may be remembered that we have already made some observations upon articles in which it was asserted that between the juice entering and that leaving the evaporators there is a loss of reducing sugars, which it was endeavoured to explain. This subject was brought to the attention of our eminent colleague Dr. H. C. PRINSEN GEERLIGS, who accordingly instituted careful control experiments throughout two campaigns in Java. It was recognized that the reducing sugars do not diminish during concentration, and that in good working the amount that one should find in juice and syrup (per cent. of the sucrose) is identical though there may sometimes be a slight increase in the syrup. However, it has now been found that there are some cases in which the syrup may really show a slight diminution of apparent reducing sugars, and this is a question to which the writer will specially return on another occasion.

During 1916 the potash output of the United States was 9720 short tons, of which 3994 tons were produced from natural salts and brines, 1850 tons from alunite and silicate rocks, 1556 tons from kelp, 412 tons from wood ashes, 1845 tons from molasses distillery vinasse, and 63 tons from miscellaneous organic sources.

Geographical Distribution of the Rind Disease of Sugar Cane.

By JOHN R. JOHNSTON,[1]

Formerly Pathologist of the Insular Experiment Station, Porto Rico.

United States.—The rind fungus (*Melanconium sacchari*) was reported by Dr. STUBBS in the *Louisiana Planter* for May 21st, 1910. EDGERTON[2] reported it as occurring only on seed cane. H. R. FULTON, formerly of the Louisiana Agricultural Experiment Station, sent to Washington specimens of *Melanconium sacchari* on cane. This was sent from New Orleans on October 19th, 1907. About 1905 Dr. ERWIN F. SMITH was growing cane in the greenhouses in Washington, D.C., for studies on the gumming disease. On much of this cane *Melanconium sacchari* appeared. In the summers of 1911 and 1913 more cane was grown in other greenhouses in Washington, and on this cane appeared much of this disease. Further than these notes there are no records of the occurrence of this disease in the States, with the exception of the author's notes. These latter report its occurrence in Florida, Georgia, Louisiana, and Texas.

Cuba.—The fungus was reported as common on dead canes, leaf-sheaths and dead leaves that had been kept in a moist place and also as frequent on dead or injured parts of living canes, by HORNE and COOKE.[3] The writer has also seen this disease on standing cane at Nipe Bay, Cuba.

Jamaica.—*Trululla sacchari* E & E identical with *Melanconium sacchari* was sent from Westmoreland County, Jamaica, and reported on by COCKERELL[4] in 1891-93. FAWCETT[5] in 1895 reported the rind disease due to *Melanconium sacchari* to be common on certain estates, especially in cane tops affected by the moth-borer.

Santo Domingo.—The author reported the rind fungus common in most of the cane districts of this island in 1913.

Porto Rico.—Cane diseased by *Melanconium sacchari* was sent from Porto Rico to the United States Department of Agriculture in Washington in 1906 (?) and was identified by the writer. TOWER[6] reported the fungus present especially on the south side of the island. FAWCETT[7] the following year reported it, stating that it was very common on the east end of the island. In the report of the writer[8] for 1910-1911 the fungus is said to be prevalent all over the island.

Barbados.—BOVELL[9] reported in 1895 in regard to the rind fungus that "in many instances so badly has the disease attacked the canes that instead of an acre giving from two to three hogsheads of sugar it will require many acres to give one hogshead."

---

[1] In *Journal of the Board of Commissioners of Agriculture*, Porto Rico, I, 1, 1917. Here abridged.

[2] EGERTON, C. W.—Some Sugar Cane Diseases Bul. No. 120, La. Agric. Expt. Sta, July, 1910, p. 16.

[3] COOKE, M T., and HORNE, W T.—Insects and Diseases of Corn, Sugar Cane, and Related Plants Bul. 7, May, 1907, p. 25. *Estación Centr. Agron de Cuba.*

[4] COCKERELL, T D. A.—A New Fungus on Sugar Cane. *Journ. Insti. Jam.* Vol. I, 1891-1893, p. 159.

[5] FAWCETT, W.—Report on Disease in Sugar Cane. Bul. Bot. Dept. Jam. n. s. Vol. II, No 8, pp. 165-167, 1895.

[6] TOWER, W V—Rept of the Entom and Path., An. Rept of the P. R Expt. Sta. for 1907, May 4th, 1908, p. 37.

[7] FAWCETT, G L.—Report of the Plant Pathologist, An. Rept. of the P. R. Agric. Expt. Sta, for 1908, pp. 34-5, 1908.

[8] JOHNSTON, J. R.—First Report of the Pathologist. Year Book of the P. R. Sugar Grower s Asso., year 1910-11, pp. 61-74.

[9] BOVELL, JOHN R.—Report on the sugar cane fungus (*Trichosphæria sacchari*) at present existing in the island. In sugar cane disease in Barbados Kew Bull. Nos. 100-101, 1895.

South[1] in 1909-1910 reported this fungus as always present on dead canes which are dry.

British Guiana.—Harrison and Jenman[2] stated that until early in 1894 the canes in British Guiana appeared to be quite free from fungoid disease, although the fungus *Trichosphœria sacchari* could be found in greater or less abundance on dead canes and on the dead parts of dying canes in probably every field in the colony, but in February, 1894, they noticed that several varieties of seedlings were affected with rind fungus. Specimens of this fungus on cane were received from both Demerara and Essequibo.

Other English Colonies in the West Indies.—Professor Harrison (*l.c.*) visited Trinidad, St. Vincent, Barbados, Antigua, Grenada, and Carriacou and found the rind fungus present in all of them. South (*l.c.*) reported as follows:—

St. Vincent.—The rind fungus occurred to a considerable extent, but chiefly in fields of the Bourbon variety of cane.

Antigua.—The fungus was not prevalent, but cases were somewhat more frequent than formerly. It was often noticed in fields badly attacked by root disease.

St. Kitts.—It was not observed to any extent.

Nevis.—It was observed on some estates. Seedling cane B147 was always more subject to attacks than any other variety.

Argentina.—Engler and Prantl[3] record *Melanconium sacchari* Massee on cane in Argentina.

Mauritius.—Prillieux and Delacroix[4] record the fungus in Mauritius. In an article entitled *La Maladie de la Canne* in *La Sucrerie Indigenie et Coloniale*, pp. 361–363, vol. vii, 2d. semester, 1894, is correspondence between Thistleton-Dyer, of Kew, and M. W. Scott, of Mauritius, and discussion of the rind disease caused by *Melanconium sacchari.* The Melanconium form was found to be very abundant. Massee records it from Mauritius in 1894.

British India.—*Melanconium sacchari* is stated by Butler[5] to be rare in British India. It is also reported from India by Massee.[6] Barber[7] also records the fungus from India

Tonquin.—The fungus was reported in this part of Indo-China by Prillieux and Delacroix (*l.c.*).

Java.—Went[8] describes its appearance in Java. His description in the Annals of Botany[9] is such, however, to lead one to suspect that he did not have the West Indian *Melanconium sacchari.* Thistleton-Dyer[10], in discussing the subject, thinks he had a very different fungus. Went describes black spherical conidia as being connected with the *Melanconium* with which he was working, and no one else has as yet published a description of such a form. He mentions chlamydospores, so that it cannot be certain just what WENT had, although these were also found by HOWARD.[1]

---

[1] South, F W —Report on the prevalence of some pests and diseases in the West Indies for the year 1909-1910. *W. I Bul.* Vol. XI, No. 2, pp 74-75, 1911.

[2] Harrison, J. B , and Jenman, G S.—Sugar Cane Diseases. In report of the agricultural work on the bot. gardens for the years 1893-4-5 Br. Guiana, 1897, pp 98-104.

[3] Engler and Prantl —*Die naturlichen Pflanzenfamilien.* Fungi, Vol I, pt. 1, pp. 403-5

[4] Prillieux and Delacroix.—*Sur une maladie de la canne a sucre produite par le Coniothyrium melasporum (Berk.) Sacc. Bul. Soc Myc. de France.* Vol. XI, p. 75, 1895.

[5] Butler, E. J.—Fungous Diseases of Sugar Cane in Bengal. Bot. Ser. Vol. I, No. 3, July, 1906. Memoirs of the Dept of Agric. in India.

[6] Massee, G.—Sugar Cane Diseases in the Old World. *Kew. Bul.*, p. 81, 1894.

[7] Barber, C. A.—Sugar Cane in the Godavari and Ganjari districts. Dept. of Land Records and Agric , Madras. Vol. II, No. 43, 1901.

[8] Went, F. A. F. C.—On the appearance of the West Indian Rind Fungus in Java. Med. Prœf. Sta., West Java. No 23, pp. 6–12

[9] Went, F. A. F. C.—Notes on Sugar Cane Diseases. *Annals of Bot.* Vol. X, pp. 585–609.

[10] Thistleton-Dyer, W.—Note on the Sugar Cane Disease of the West Indies. *Annals of Bot.* Vol. XIV, 1900, pp. 609–616.

Natal.—FULLER[2] reported in this colony a fungus on sugar cane supposed by him to be *Strumella sacchari*, which, as we have seen, is identical with *Melanconium sacchari.*

Queensland.—The first description of *Strumella sacchari* was by COOKE[3] from a specimen received from Queensland. TRYON[4] also records the occurrence of the rind disease in this country.

New South Wales.—COBB[5] reported *Strumella sacchari* as occurring there.

Hawaii.—PERKINS[6] in 1904 stated that "nearly a year ago, . . . an unusual outbreak of some parasitic leaf-fungi was noticed, and this was shortly followed by a similar spread of fungous diseases affecting other parts of the cane. It must not be supposed that these fungi are new to this country; they have been known to us for at least some years sporadically, but are not epidemic. The present epidemic is clearly due to the abundance of the leaf-hopper.

"At present by far the most widespread and injurious of these diseases is the so-called Rind Disease. . . . . On examining the stripped stem of young cane, I find that the fungus has already attacked this severely. . . . . Whole fields of cane are simply saturated with the spores of the fungus."

COBB[7] in 1906 stated that he had "noted the presence of rind disease in sufficient quantity to call for remedial action." LEWTON-BRAIN[8] described the rind disease and the loss caused by it in 1907. COBB[9], writing again in 1909, said that in many fields, especially ratoon fields of Lahaina cane, it was common to find the sheaths of the "*lalas*" (shoots from the top of the cane) attacked by rind disease. "I have seen fields of this kind in which nearly every *lala* showed the spores of rind disease issuing from the sheaths of its lowest leaves, and when the higher leaves were pulled away it was evident that these, too, were attacked and in the first stages of the disease."

According to Treasury minutes recently published, purchases of sugar by the Royal Commission on Sugar Supplies to the extent of £1,000,000 were authorized on May 10th last, while on June 7th arrangements were made for financing additional transactions, involving an outlay of £2,000,000.

The "German-American Sugar Company" of Bay City, Michigan, has recently changed its name to "The Columbia Sugar Company." Another change of name is reported from Canada where the town of Berlin, the venue of the Dominion Sugar Co., is henceforward to be known as Kitchener.

---

[1] HOWARD, A.—On Some Diseases of Sugar Cane in the West Indies. *Annals of Bot* Vol XVII, pp. 373-412, 1903.

[2] FULLER, C.—Sec. Rept. of the Govt. Entom. Nat. Dept. Agric., 1901, pp. 72, pls. 3, figs. 23.

[3] COOKE, in Grevillea Vol. XIX, p. 45.

[4] TRYON, H.—Some Obstacles to the Successful Cultivation of Cane. *Queensland Agric. Journ.* Vol. IX, p. 85, 1901.

[5] COBB, N. A.—*Agric. Gaz., New South Wales.* Vol. IV, pl. 10, pp. 777-857, 1893.

[6] PERKINS, R. C. L.—On some diseases of sugar cane. *Hawaiian Forester and Agriculturist.* Vol. I, No. 4, 1904, pp. 80-84.

[7] COBB, N. A.—Fungus Maladies of the Sugar Cane. Bul. No. 5, Haw. Sugar Planters' Asso., 1906, 106-110.

[8] LEWTON-BRAIN, L.—Rind Disease of the Sugar Cane. Bul. 7, Haw. Sugar Planters' Asso., 1907.

[9] COBB, N. A.—Fungus Maladies of the Sugar Cane. Bul. No. 6, Haw. Sugar Planters' Asso., 1909, pp. 39-40.

Obituary.

ALFRED CHAPMAN, M.Inst.C.E.

We regret to announce the death of Mr. ALFRED CHAPMAN, M.Inst. C.E., Director of Messrs. Fawcett, Preston & Co., Ltd., Liverpool, which occurred on the 11th July last.

ALFRED CHAPMAN, who was born in 1839, and thus had attained the ripe age of 78, was the son of the late JAMES CHAPMAN, Commander, R.N.; he started his professional life by serving two years as apprentice in a Preston foundry, and then entered the Phoenix Foundry of Messrs. Fawcett, Preston & Company, Liverpool. In 1861, after one or two trips abroad, he joined his brother in Cuba as a consulting engineer, and while there obtained the practical and theoretical knowledge of multiple effect evaporation of sugar, which was to serve him in such good stead in later years. After a visit to Egypt in 1870 to design and construct two large sugar factories for the Khedive Ismail Pasha, he in 1872 joined the firm of Fawcett, Preston & Company as a partner, and thereafter took an active part in the technical management of the business, which continued till the time of his death.

He was a most genial man, and an exceedingly clever engineer. He was the first to introduce (in 1875) the system of central condensation in connexion with vacuum pans, while in 1888 he took out a patent for improving the circulation of juices in evaporators. Besides his well known sugar engineering work, he was a good writer on engineering and other subjects, and contributed to the *Times* and other journals; he was also the writer of the article on "Sugar" in the 11th edition of *Encyclopaedia Britannica*.

H. F. EASTON.

We regret to record the death through accident of Mr. HERBERT FYFE EASTON, which took place on June 24th when engaged on important experimental work for the Ministry of Munitions. Mr. Easton's name was a familiar one to those engaged on beet sugar propaganda work in this country, and it was only three months ago that two contributions on the subject from his pen appeared in succeeding issues of this journal.

His connexion with beet sugar only dated from 1913, as he was previously for some 17 years manager of explosives factories and made powder for the Boer War. In that year, however, he became secretary of the Anglo-Netherland Sugar Corporation and filled that position with eminent ability in spite of many difficulties. In 1914 he was sent to Cantley, where he had charge of the factory and all the Company's operations, in addition to the position of secretary. Here he showed as great ability in factory management as he had in the previous secretarial work. In 1915, owing to the Dutch embargo on beet seed, the Cantley factory had to close down, whereupon Mr. EASTON, who was recognized as one of the leading authorities on explosives, left the Corporation to undertake national work under the Ministry of Munitions. It was when so engaged that he met with the fatal accident which cut short his life and robbed the country not only of a valuable war time expert but also one of our most enthusiastic pioneer workers in the cause of a British beet sugar industry. Mr. EASTON, who was 50 years of age, had in the brief period of years he was connected with this branch of agricultural industry made a thorough study of its possibilities, and one of his latest appointments was as an expert adviser to the lately formed British Sugar Beet Growers' Society Ltd., which has the new Kelham sugar factory in hand.

Spain.

SUGAR PRODUCTION IN 1916.

The following statistics regarding sugar production in Spain in 1916 are taken from a report recently issued by the Director-General of the Spanish Customs as published in the *Board of Trade Journal*:—

Cane Sugar.—The area under sugar cane cultivation in 1916 was approximately 1194 hectares, the total yield of cane being 44,395 metric tons, and of unrefined sugar 4264 metric tons. The 1915 production was 63,876 tons of cane and 5595 tons of sugar, and the 1914 yield 72,321 tons, and 7376 tons respectively. The prices paid for the cane during the last harvest varied between 30 and 46 pesetas[1] per metric ton delivered at factory During the season ten factories and six mills were working.

Beet Sugar.—The area under beet in 1916-17 season amounted to 54,315 hectares, the production being, up to 31st December last, 752,891 metric tons, and the yield of sugar 82,212 metric tons. The total yield of the 1915-16 harvest was 723,557 metric tons of beet and 77,115 metric tons of sugar. Great variations in price have taken place, quotations ranging from 35 to 60 pesetas per metric ton. At the end of year 31 factories were working.

Stocks.—The total stocks of sugar at 31st December, 1916, amounted to 84,662 metric tons, as compared with 89,366 tons and 143,618 tons at the end of 1915 and 1914 respectively.

Consumption.—The total consumption of sugar in Spain last year was 109,549 metric tons, as compared with 156,618 tons in 1915, and 126,426 tons in 1914.

Publications Received.[2]

***A Short History of Sugar 1856-1916: a Warning.** By George Martineau, C.B. Paper, 32-mo, 85 pp. (London: British Empire Producers' Organization, Kingsway, W.C.). 1s. net.

This timely booklet was written by our recognized leading authority on sugar economics at the special request of the British Empire Producers' Organization, who wished to have a summary account of the sugar problem during the past sixty years, to enable a new crowd of students of this economical question (such as the war has brought in its train) to master with a minimum of trouble the chief points of history that bear on the subject. Mr. MARTINEAU depicts in his usual lucid style and as briefly as possible the chief features of the story of the German domination of the British sugar market before the war, "beginning with the days before the Deluge, passing to the rise and progress of German competition in the sugar markets of the world which resulted in a practical monopoly of the British market, and finishing with the sad story of sugar during the war and some anticipations of the vital and urgent necessity for a complete revolution in our economic policy if British industries are to be defended in future against such state-aided hostile attacks from outside." It has all been told at one time or other by him in our pages, during the past thirty or forty years; but the present epitomé of it in this brochure is an opportune addition to the library of general economics in view of the revolution in thought to which the present war has given rise.

---

[1] 25 pesetas = £1.

[2] Books and other Publications marked with an asterisk (*) can be ordered if desired through NORMAN RODGER, 2, St. Dunstan's Hill, London, E.C. 3, but in that event the order should be placed with him direct and not through a bookseller Those not so indicated should preferably be ordered from the source of publication, especially pamphlets to which no price is attached, as these are in many instances gratis. Postage as a rule is extra.

Annual Reports of the Society of Chemical Industry on the Progress of Applied Chemistry. Volume I. (Society of Chemical Industry, Broadway Chambers, Westminster, London, S.W.) 1917. Price: 3s. (post free) to members; 5s. 6d. (post free) to others.

These Reports, which the Society of Chemical Industry has decided to issue annually at the suggestion, we understand, of Mr. E. V. EVANS, present a critical summary of the progress that has been made in the various branches of chemical industry during the period in question. This innovation will be welcomed by all interested in technical chemistry, and is particularly opportune at this time, when considerable development is being made in certain branches, and doubtless later its advantages will be more apparent. It has not been found practical to follow every section of the system of classification adopted in the *Journal of the Society of Chemical Industry.* Agricultural Chemistry, the Chemistry of Foods, and Analysis, for example, are dealt with fully in the admirable series of Reports which have for some time been issued annually by the Chemical Society, and for obvious reasons it would be undesirable at present to include sections on General Plant and Explosives. The following is a list of the subjects treated, with the names of the experts contributing to the volume:—Fuel, J. W. Cobb, B.Sc.; Gas, Destructive Distillation, Tar Products, E. V. Evans, F.I.C.; Mineral Oils, J. W. Cobb, B.Sc.; Colouring Matter and Dyes, Prof. G. T. Morgan, D.Sc., F.R.S.; Acids, Alkalis, Salts, etc., H. A. Auden, D.Sc.; Glass and Ceramics, J. A. Audley, B.Sc.; Building Materials, J. A. Audley, B.Sc.; Oil, Fats, and Waxes, G. H. Warburton, F.I.C.; Paints, Pigments, Varnishes, and Resins, R. S. Morrell, M.A., Ph.D.; India-rubber, etc., H. P. Stevens, M.A., Ph.D., F.I.C.; Leather and Glue, J. T. Wood, F.I.C.; Fermentation Industries, A. R. Ling, F.I.C.; Water Purification and Sanitation, F. R. O'Shaughnessy, F.I.C.; Fine Chemicals, Medicinal Substances, and Essential Oils, F. L. Pyman, D.Sc., Ph.D.; Photographic Materials and Processes, B. V. Storr, M.Sc.

The Sugar Supply of the Empire, its Production and Distribution. By C. Sandbach Parker, Chairman of British Empire Producers' Organization. Paper, 33 pp. Demy 8vo. (London: British Empire Producers' Organization, Kingsway, W.C.).

A reprint of a lecture given by Mr. C. SANDBACH PARKER before the London School of Economics last May (as described on p. 258 of our June issue). A useful work of reference in view of the numerous statistics it contains.

Nitro-starch[1] has now come into use as an explosive, having many advantages over nitro-cellulose. It is economical, is not bulky, and cannot be exploded except by a cap in contact with it. It gives off no bad fumes, is non-freezing, and appears to have good stability. Moreover it is cheap, being made from a raw material costing about 1d. per lb., as compared with glycerin at 1s. 6d. to 2s. 6d. per lb., and there is no special difficulty in its manufacture.

Dr. LANGGUTH STEUERWALD, of the Sugar Experiment Station, Pekalongan, Java, on being interrogated regarding the relative merits of ultramarine and indanthrene for "blueing" sugar, replied[2] that the latter possesses the advantage that it is affected neither by acids nor alkalis, and that on being boiled with water it cannot give off sulphuretted hydrogen, which some of the inferior ultramarines may do. On the other hand, its colour is not such a pure blue as that of the high-grade ultramarine used in the sugar factory or refinery, and in consequence it does not impart such a fine neutral tint to the sugar as does good ultramarine.

---

[1] S. S. SADLER. *Metallurgical and Chemical Engineering*, 1917, 16, No. 7, 361.

[2] *Archief*, 1916, 24, 1009.

Brevities.

According to De Silva's *Monthly Report*, there is still a quantity of Ilo Ilo sugar lying in London imported under free licence, which is only allowed to be sold to manufacturers, the latest excuse for the prohibition of its sale for domestic use being that the Health Authorities object; yet millions of people in the East use this class of sugar or even a lower one.

In the United States the cost of refining has greatly increased as compared with previous years owing to the enhanced cost of labour, coal, animal char, and other items entering into the process of refining, and in most instances it is now said to amount to over 1 cent per lb.

According to Dr. Geerligs in the *Louisiana Planter*, the well-known German Institute for the Sugar industry at Berlin, which for the last 30 years has been directed by Professor Herzfeld, has lately celebrated its fiftieth anniversary. In happier times it would have been an occasion for world-wide congratulation, but as it is, there is not a sugar country of any importance with the exception of Holland which is not at war with Germany and all her works, so the celebration was necessarily confined to "rather narrow limits."

The *Louisiana Planter* reports that a Bill is now before the Cuban Senate which if passed will regulate the cane contracts between the cane growers and the sugar factories, and will enforce the fulfilment of the reciprocal obligations specified in these contracts. One stipulation is that all contracts whether public or private must be recorded in a special book by the Registrar of Ownership, to be called "The Book of Cane Contracts." It is hoped by this reform to obviate the differences which frequently occur between the centrals and the landowners and farmers, relative to the buying, selling, and delivery of

The *West India Committee Circular* gives prominence to a suggestion of the Dominions Royal Commission which has lately been sitting that an "intermediate" service of steamers might in future be run to Australia and New Zealand viâ Halifax, Bermuda, Jamaica, and the Panama Canal, thereby bringing these portions of the British Empire into direct communication. The route in question is only 400 miles longer than would be a direct route viâ Jamaica and Colon, so that the linking up of Canada and Bermuda with Jamaica and Australasia would involve little extra time for the voyage, while offering great opportunities for increased trade.

In view of the scarcity of coal or wood in many sub-tropical regions, it is interesting to note the report recently made by Sir F. Nicholson (a summary of which is given in the *Indian and Eastern Engineer*), describing, amongst other things, valuable experiments in the employment of solar ovens. These consist of stout teakwood boxes, blackened inside and fitted with a double glass top. They are suitably insulated, and with this simple apparatus a temperature of from 240° to 275°F. is easily obtained during the middle of the day, and 290° with the aid of a single glass mirror. The oven once constructed costs nothing, and for all mere baking or cooking purposes it is a very efficient and cheap utilization of sun heat, suitable for many applications.

It is interesting to speculate upon the source of the supply of sulphur for the manufacture of sulphuric acid in Germany during the war. A large amount, at least 300,000 tons of pyrites annually, is produced in Megan, Silesia, and some in the early part of the war may also have been obtained from Norway. Other sources perhaps have been found in Poland, Greece, or Turkey. Besides this, it is stated by M. Cazeneuve, that German chemists have succeeded in producing sulphuric anhydride from calcium sulphate (plaster of Paris) by calcination in the electric furnace, while a modification of this process in which sand is previously mixed with the calcium sulphate is reported to yield in addition a good cement.

Review of Current Technical Literature.[1]

Determination of Levulose in Honey, Jam, and other Substances.

W. R. G. Atkins. Analyst, 1917, 42, 12-13.

When determining levulose in the presence of other reducing sugars, if the maltose be hydrolysed by prolonged boiling with acid, so much levulose is destroyed as to render the estimation worthless. But the oxidizing action of bromine in removing aldehydic sugars, while leaving the ketonic sugar levulose untouched, may be made use of in order to obtain a reliable result.

Thus, if a mixture containing dextrose, levulose, and maltose, to which has been added an excess of bromine and enough sulphuric acid to render the solution deci-normal, be allowed to remain for 42 hours at room temperature, the levulose only is oxidized.[2] After this time, during which the liquid has been shaken continuously, the excess of bromine is removed by the addition of sulphurous acid, the solution is nearly neutralized by potassium carbonate, and the reducing power determined by Kendall's method.[3]

By this means the levulose may be estimated readily and with tolerable accuracy in the presence of dextrose and maltose, or either of them. If only dextrose and levulose are present, as in natural honey, which contains about 36 per cent. of the latter, it is sufficient to ascertain the reducing power before and after the oxidation with bromine. If sucrose be present, it must be estimated separately by determining the reducing power before and after inversion, the oxidation with bromine being effected on the inverted solution, and due allowance made for the dextrose and levulose resulting from the inversion. It is pointed out that when dextrose and levulose are estimated in a mixture of the two by obtaining the total reducing power and the optical activity, and constructing two equations, errors are magnified, and the procedure is not so accurate as the determination of reducing power before and after oxidation, as now proposed. This new method may be of use in the technical analysis of honey, jams, and other products, especially as it affords an easy means of detecting the presence of dextrose in abnormal quantities.

Tables for the Dilution of Sugar Syrup to a Desired Gravity for Use in Fruit Canning and Preserving.

James B. McNair. Journal of Industrial and Engineering Chemistry, 1917, 9, No. 21, 151- 153.

In many factories canning and preserving fruit, a concentrated syrup is first made, which is afterwards diluted to the various strength that the particular fruit may require, fruit of a high acidity demanding a high percentage of sugar, and *vice versa*, and fruit of delicate flavour requiring less sugar than that which is strongly flavoured. That the methods used in this dilution are not always adequate would appear to be shown by data collected by the writer showing a lack of uniformity of gravity for the same class of product. Experiments have therefore been conducted on a small scale with the purpose of compiling tables which can conveniently be used for obtaining quantities from 5 to 65° Brix. Table I was

---

[1] This Review is copyright, and no part of it may be reproduced without permission.—(Editor, *I.S.J.*)

[2] The maltose leaves a mere trace of reducing power, and levulose falls off in reducing power 1 to 2 per cent., owing to its decomposition, even in the cold, by the N/10 acid and by the hydrobromic acid formed during the oxidation of the other sugars However, the slight loss in the quantity of levulose is roughly balanced by the reducing power remaining after the destruction of the dextrose and maltose.

[3] *J. Amer. Chem. Soc.*, 1912, **34**. 317-341 ; and *Analyst*, 1914, **41**, 285 Briefly the method consists in modifying Fehling's solution by substituting potassium carbonate for caustic soda, and salicylic acid for Rochelle salt. The cuprous oxide is filtered off, dissolved in nitric acid, and the copper determined by the modified iodide method as described in *Jl. Amer. Chem. Soc.*, **1911-33**, **1947**.

TABLE I—SHOWING GALLONS OF WATER, OR OUNCES OF SUGAR PER GALLON OF SYRUP, REQUIRED TO CHANGE A SYRUP FROM A GIVEN DEGREE BRIX TO ANOTHER GIVEN DEGREE BRIX AT 17° C.

Above dashes read "Ounces of sugar added per gallon of Syrup"

Desired Brix Degree:	0	5	10	15	20	25	30	35	40	45	50	55	60	65
0		7·1	14·5	22·7	32·1	43·0	55·8	71·0	88·8	109·7	134·9	172·2	194·6	231·6
5		—	7·2	15·1	24·2	34·8	47·2	61·9	79·1	99·4	123·8	150·3	181·6	218·5
10		0·98	—	7·7	16·5	26·7	38·7	53·0	69·7	89·3	113·0	138·6	169·0	203·6
15		2·00	0·513	—	8·5	18·4	30·0	43·8	60·0	78·9	101·8	126·5	155·9	189·5
20		3·08	1·062	0·364	—	9·5	20·7	34·0	49·5	67·8	89·8	113·7	142·0	174·4
25		4·25	1·650	0·752	0·284	—	10·7	23·4	38·3	55·8	76·9	99·8	126·9	157·8
30		5·47	2·27	1·164	0·587	0·235	—	12·1	26·3	42·9	63·0	84·8	110·6	140·0
35		6·81	2·94	1·608	0·912	0·488	0·206	—	13·4	29·2	48·2	68·8	93·3	121·3
40		8·18	3·63	2·06	1·246	0·748	0·419	0·177	—	14·8	32·7	52·0	74·9	101·1
45		9·58	4·35	2·54	1·597	1·023	0·639	0·360	0·155	—	16·7	34·7	56·2	80·6
50		11·1	5·10	3·03	1·960	1·307	0·870	0·552	0·318	0·141	—	16·7	36·6	59·3
55		12·5	5·80	3·50	2·30	1·570	1·086	0·732	0·471	0·273	0·115	—	18·4	39·5
60		13·9	6·53	3·98	2·66	1·850	1·305	0·914	0·625	0·407	0·232	0·104	—	19·4
65		15·7	7·44	4·58	3·08	2·17	1·562	1·122	0·797	0·552	0·355	0·211	0·094	—

Below dashes read: "Gallons of water added per gallon of syrup"

EXAMPLE 1: To change a syrup of 5° Brix at 17° C to a syrup of 10° Brix at 17° C, add 7·2 oz. of sugar per gallon of syrup

EXAMPLE 2: To change a syrup of 10° Brix at 17° C to a syrup of 5° Brix at 17° C, add 0·98 gallon of water for every gallon of syrup.

TABLE II—SHOWING GALLONS OF WATER, OR OUNCES OF SUGAR PER OUNCES OF SUGAR OR GALLONS OF WATER, IN SYRUP REQUIRED TO CHANGE A SYRUP FROM A GIVEN DEGREE BRIX TO ANOTHER DEGREE BRIX AT 17° C.

Above dashes read: "Ounces of sugar added per gallon of water in syrup."

Desired Brix Degree:	0	5	10	15	20	25	30	35	40	45	50	55	60	65
0	—	7·1	14·5	22·7	32·1	43·0	55·8	71·0	88·8	109·7	134·9	162·2	194·6	231·6
5		—	7·4	15·6	25·0	35·9	48·7	63·9	81·7	102·6	127·8	155·1	187·5	224·5
10		0·072	—	8·2	17·6	28·5	41·3	56·5	74·3	95·2	120·4	147·7	180·1	217·1
15		0·097	0·0249	—	9·4	20·3	33·1	48·3	66·1	87·0	112·2	139·5	171·9	208·9
20		0·110	0·0379	0·0130	—	10·9	23·7	38·9	56·7	77·6	102·8	130·1	162·5	199·5
25		0·118	0·0458	0·0209	0·0079	—	12·8	28·0	45·8	66·7	91·9	119·2	151·6	188·6
30		0·123	0·0511	0·0262	0·0132	0·0053	—	15·2	33·0	53·9	79·1	106·4	138·8	175·8
35		0·127	0·0549	0·0300	0·0170	0·0091	0·00384	—	17·8	38·7	63·9	91·2	123·6	160·6
40		0·130	0·0577	0·0328	0·0198	0·0119	0·00666	0·00282	—	20·9	46·1	73·4	105·8	142·8
45		0·132	0·0599	0·0350	0·0220	0·0141	0·00880	0·00496	0·00214	—	25·2	52·5	84·9	121·9
50		0·134	0·0616	0·0367	0·0237	0·0158	0·01051	0·00667	0·00385	0·00171	—	27·3	59·7	96·7
55		0·135	0·0628	0·0379	0·0249	0·0170	0·01176	0·00792	0·00510	0·00296	0·00125	—	32·4	69·4
60		0·136	0·0639	0·0390	0·0260	0·0191	0·01278	0·00894	0·00612	0·00398	0·00227	0·00102	—	37·0
65		0·137	0·0647	0·0398	0·0288	0·0189	0·01360	0·00976	0·00694	0·00480	0·00309	0·00184	0·00082	—

Below dashes read: "Gallons of water added per ounces of sugar in syrup."

EXAMPLE 1. To change a syrup of 5° Brix at 17° C to a syrup of 10° Brix at 17° C, add 7·4 oz. of sugar per gallon of water in syrup.

EXAMPLE 2: To change a syrup of 10° Brix at 17° C to a syrup of 5° Brix at 17° C., add 0·072 gallon of water per oz. of sugar in syrup calculated by the formula: $y=1.4x+0{\cdot}002512x^3$, where $x=$ the degrees Brix of the syrup, and $y=$ the ounces of sugar added per gallon of water at 17° C. It was obtained by the interpolation of experimental results. In determining the amount of sugar necessary to add to a fruit juice or extract for jelly making, no compensation need be calculated for extracts of less than 15° Brix, and the right amount of sugar in ounces (more than 60° and less than 70° Brix) may be obtained by adding 1·8 times the number of ounces of fruit extract.

NATURAL ENEMIES OF SUGAR CANE BORERS IN JAVA. *P. van der Goot.* *Mededeelingen, 5, 125- 176.*

A catalogue and description of the natural enemies of the sugar cane borers are given. Of the latter, the following species are known in Java: *Diatraea striatalis* Sn (Gestreepte Stengelboorder); *Chilo infuscatellus* Sn (Gele Topboorder); *Scirpophaga intacta* Sn. (Witte Topboorder) *Grapholita schistaceana* Sn. (Grauwe Boorder). The natural enemies are divided in two groups; egg-parasites and larva-parasites; among the first, *Phanurus beneficiens* Zehntner attacks the eggs of *Diatraea*, *Chilo*, and *Scirpophaga; Trichogramma australicum* Girault attacks *Diatraea* and other injurious insects; *Trichogrammatoidea nana* Zehnt. attacks *Diatraea* and *Grapholita.* In the list of parasites of the larvae of *Diatraea* and *Chilo*, insects hitherto unknown in Java, are: (1) *Iphiaulax medianus* Cam., *Iphiaulax* sp., *Cremnops parvifasciatus* Cam., *Cremnops* sp., *Mesostenoideus* sp., all in British Guiana; (2) *Ophion mauritii*, in the Island of Mauritius; (3) *Tachinidaé* spp., in British Guiana and Porto Rico; (4) *Licoderma 4-dentatum* common in British Guiana; (5) an Elater and *Chauliognatus marginatus*, *Drasterius elegans* in Louisiana. Of importance are *Telenomus* sp. and *Heptasmicra curvilineata* Cam. enemies, the first of the larvae, the second of the pupae, of *Diatraea* in British Guiana. Particulars are also given of the experiments made for the purpose of spreading and breeding *Trichogramma* and *Phanurus*, which are without doubt the most efficacious parasites for the control of the borers of the sugar cane.

THE SACCHARIMETRIC NORMAL WEIGHT AND SPECIFIC ROTATION OF DEXTROSE. *Richard F. Jackson.* *Scientific Papers of the Bureau of Standards, No. 293.*

Dextrose obtained both from starch products and from invert sugar was purified by repeated crystallization from aqueous solution, and portions from these two sources subjected to fractional crystallization showed essential identity in every respect in all their fractions, while precipitation by ethyl alcohol produced similar products. The density of dextrose solutions is given by the following formula, valid between 5 and 30 per cent., the values being reliable to 3 or 4 units in the fifth decimal place:—

$$D\frac{20^\circ}{4^\circ}=0{\cdot}99840+0{\cdot}003788\,p+0{\cdot}00001412\,p^2,$$

where p is the per cent. of dextrose by weight *in vacuo.* The normal weight of dextrose is 32·231 grms. (sugar scale) weighed in air and with brass weights, that of sucrose being 26·00 grms. The specific rotation of dextrose at concentrations less than normal vary considerably from proportionality, and formulae are given representing these values.

TESTING OF GLASS VOLUMETRIC APPARATUS. *Anon.* *Circular of the Bureau of Standards, No. 9.*

In order to encourage excellence in quality, the Bureau is co-operating with makers and users of glassware volumetric apparatus in endeavouring to establish standards. General specifications are drawn up, these concerning the temperature, the material and annealing, the design and workmanship, and the inscription; but certain stipulations are made, which are of importance in furthering uniformity of construction and marking. For example, as regards flasks, limits are given for the internal diameter of the neck at the capacity mark, and of the distance of the mark from the upper and lower ends. In the case of a 100 c.c. flask, the maximum and minimum diameter should be 12 and 8 mm. at the mark, and the mark should not be nearer the top end than 3 cm., nor 1 cm. from the lower one. It is interesting to record the limit of error in c.c. for flasks, pipettes, burettes, and cylinders, that may be regarded as acceptable, these being as follows:—

Flasks.

Capacity, c.c.	Limit of error, c c. To contain.	Limit of error, c c. To deliver.
50	0·05	0·10
100	0·08	0·15
200	0·10	0·20
500	0·15	0·30
1000	0·30	0·50

Transfer Pipettes.

Capacity.	Limit of error, c.c.
5	0·01
10	0·02
30	0·03
50	0·05
100	0·08

Burettes and Measuring Pipettes.

Capacity, c.c.	Limit of error. c.c. Burettes.	Limit of error. c.c. Measuring Pipettes.
5	....	0·02
10	....	0·03
30	....	0·05
50	0·05	0·08
100	0·10	0·15

Graduated Cylinders.

Capacity, c c.	Limit of error, c.c. To contain.	Limit of error, c.c. To deliver.
10	0·03	0·05
25	0·06	0·10
100	0·20	0·50
250	0·45	0·70
500	0·85	1·30
1000	1·60	2·40

The delivery time of any instrument must be stated, and the error should not exceed more than a certain value, here stated. Some useful hints on manipulation are also given.

SUGAR CANE VARIETIES OF MAURITIUS, 1915. **Henri Robert.** *Department of Agriculture, Mauritius, Bulletin No. 2, Statistical Series.*

White Tanna is grown on 47·06 per cent. of the land in Mauritius, upon which cane is cultivated: M.P. 55 on 14·46; Striped Tanna on 8·76; D. 130 on 5·27; and Lousier and Uba on only 1·03 and 0·17 per cent. respectively. Out of a total of 47 varieties recorded, 35 are seedlings, while the 12 others are composed of the Tannas, Fotiogo, Iscambine, Uba, Bambou, Badilla, Port Mackay, and other canes. Particulars are given regarding the distribution of the several varieties in different districts. The total area under cane cultivation at a height 600 ft. above sea-level is 28,672 arpents (65·9 per cent.), and that below 600 ft., 55,620 (34·1 per cent.), a total of 84,293 arpents. On lands above 600 ft., White Tanna, Striped Tanna, and M.P. 55 are the varieties most grown (63·5, 11·0, and 10·81 per cent. respectively); and below this height, White Tanna, Striped Tanna, M.P. 55, M.P. 131, D. 130, DK. 74 (38·5, 7·6, 16·4, 6·7, 7·9, 7·5 per cent. respectively). D. 130 is but little grown at heights above 600 ft. It is pointed out that a very large proportion of the White Tanna originated from a white "sport" yielded by the Striped Tanna at Pamplemousses Gardens and on several estates of the colony; but that in 1895 a cane called the Green (syn. White) Tanna was received from the Department of Agriculture of New South Wales. The Striped Tanna itself was received in 1890 from Queensland. The Black Tanna is also a local "sport" from the Striped Tanna, and these Tanna canes were at first inferior to the varieties formerly in favour as: Louzier, Bambou, Mignonne, Bois-rouge, Tamarin, etc., but gradually became acclimatized and extended, as the older varieties became affected with "gumming" and other diseases. It would seem that in no country are cane varieties so prone to "sporting," and that in no other have "sports" played such an important part in the economic life of the sugar industry.

LOSS OF FERTILIZERS BY LEACHING.

S. E. Collinson and S. S. Walker. University of Florida, Agricultural Experiment Station, Bulletin 132, 1916.

Large steel tanks were sunk in the soil, each of which was provided with an opening in the bottom to which was fitted a drainage pipe, and four of these tanks, filled with soil, were placed about a central collecting pipe, into which the drainage pipes extended. Excess rainfall above that which the soil could hold, therefore, percolated through the soil in the tanks and appeared in the drainage pipes, from which it was collected for measurement and analysis. It was found by working in this way that newly-cleared land exposed to heavy rainfall soon loses much of its fertility through leaching, and that the greatest loss occurs with nitrogen. Phosphoric acid and potash, being present in insoluble forms, are lost in comparatively small quantities. Lime, on the other hand, leaches in considerable amount, so that an acid condition of the soil sets in. When cultivated soils are fertilized with a complete fertilizer, here too the element lost in the greatest amount is nitrogen. Nitrate of soda leaches more rapidly and in larger quantity than sulphate of ammonia or dried blood, and it should be used in small amount and at frequent intervals usually as a top-dressing. Soils similar to that used in this work have the capacity of fixing large quantities of phosphoric acid applied in the form of acid phosphate, and such soils have also the property of fixing considerable potash, though in this case the power is soon exhausted, so that afterwards relatively large amounts are lost through leaching.

CONSTANTS OF THE QUARTZ-WEDGE SACCHARIMETER AND THE SPECIFIC ROTATION OF SUCROSE: THE CONSTANTS FOR THE 26 GRM. NORMAL WEIGHT.

Frederick Bates and Richard F. Jackson. Scientific Papers of the Bureau of Standards, No. 268.

The ratios of the rotations of quartz and sugar for $\lambda = 5461$ A and $\lambda = 5892{\cdot}5$ A have been determined. For quartz: $\frac{\phi\lambda = 5892\ 5\ \text{A}}{\phi\lambda = 5461\ \text{A}} = 0{\cdot}85085$; and for sugar: $\frac{\phi\lambda = 5892{\cdot}5\ \text{A}}{\phi\lambda = 5461\ \text{A}} = 0{\cdot}84922$.

The reading of the normal sugar solution on the Herzfeld-Schonrock scale has been shown to be $99^\circ{\cdot}89_5$ S. The absolute rotation of the normal sugar solution has been determined with the following results:—

$$\text{Normal sugar solution} = 100^\circ = 34^\circ{\cdot}617\ (\lambda = 5892{\cdot}5\ \text{A})\ \text{at}\ 20^\circ\ \text{C.}$$

$$\text{Normal sugar solution} = 100^\circ = 40^\circ{\cdot}763\ (\lambda = 5461\ \text{A})\ \text{at}\ 20^\circ\ \text{C.}$$

The conversion factor has been determined for two mono-chromatic sources with the following results:—

$$\text{Normal quartz plate} = 100^\circ\ \text{S} = 34^\circ{\cdot}620\ (\lambda = 5892{\cdot}5\ \text{A})\ \text{at}\ 20^\circ\ \text{C.}$$

$$2^\circ{\cdot}8885\ \text{S} = 1^\circ\ (\lambda = 5892{\cdot}5\ \text{A})$$

$$\text{Normal quartz plate} = 100^\circ\ \text{S} = 40^\circ{\cdot}690\ (\lambda = 5461\ \text{A})\ \text{at}\ 20^\circ\ \text{C.}$$

$$2^\circ{\cdot}4576\ \text{S} = 1^\circ\ (\lambda = 5461\ \text{A})$$

The difference between the rotations of the normal quartz plate and the normal solution for $\lambda = 5892{\cdot}5$ A, has been found to be 0° 003, and for $\lambda = 5461$ A, 0°·073. These values indicate that the rotary dispersion curves of plate and solution cross at about $\lambda = 0{\cdot}585\mu$. The reading of the normal solution on the true saccharimeter scale with the source $\lambda = 5892{\cdot}5$ A, has been calculated to be 99°·99 S.

The difference in rotation in sugar degrees, for the normal solution on the saccharimeter, for the sources $\lambda = 5461$ A and $\lambda = 5892{\cdot}5$ A, has been calculated from the absolute rotations, with the following result:—
Saccharimeter reading ($\lambda = 5461$ A) — saccharimeter reading ($\lambda = 5892{\cdot}5$ A) $= 0^\circ{\cdot}19_2$ S. An independent experimental determination has been made of this difference and the values 1·5934 mm. and 1·5940 mm. obtained.

The specific rotations of sugar for the normal solution for $\lambda = 5892{\cdot}5$ A and $\lambda = 5461$ A have been calculated from the absolute rotations with the following results:—

$$\left[\alpha\right]^{20}_{\lambda = 5892\cdot5\text{ A}} = 66^\circ{\cdot}529 \qquad \left[\alpha\right]^{20}_{\lambda = 5461\text{ A}} = 78^\circ{\cdot}342$$

The agreement between the accepted value, 66°·502, for the specific rotation and 66°·529, in contrast to the disagreement between 66°·502 and the specific rotation 66°·627 from the Herzfeld-Schönrock conversion factor, has been shown to corroborate the new value, 34°·620 ($\lambda = 5892{\cdot}5$ A), for the conversion factor.

LEVULOSE THE PREPONDERANT SUGAR OF APPLE JUICES. *John R. Eoff, Jr.* *Journal of Industrial and Engineering Chemistry, 1917, 9, No. 6, 587-588.*

Twenty varieties were examined, 15 of which were native, and 5 were French cider apples. Operating according to Thompson and Whittier's method[1], 26 grms. of the expressed juice were clarified with lead acetate, made up to 100 c.c., the excess of the defecant removed by potassium oxalate, and the liquid filtered. After taking the direct reading at 20° and at 87° C., inversion was effected with invertase, these readings also being taken at 20° and 87° C., the results being calculated by the following formulæ:—

$$L = \frac{a - a^1}{0{\cdot}624} \qquad D = \frac{b^1}{0{\cdot}794} - L \qquad S = \frac{a - b}{1{\cdot}317}$$

in which L, D, and S are the percentage of levulose, dextrose, and sucrose respectively; a and a^1, the direct readings at 20° and 87° C.; and b and b^1, the invert readings at 20° and 87° C. As a control, the different sugars were also determined by Browne's method[2], using Munson and Walker's table for the reducing sugars, and the following formulæ for the calculation:—

$$y = \frac{0{\cdot}793 + S - P}{2{\cdot}08} \qquad x = R - 0{\cdot}915\, y$$

in which x and y are respectively the percentages of dextrose and levulose; R, the reducing sugars as dextrose; P, the polarization of a normal sugar weight solution at 20° C.; and S, the sucrose.

In confirmation of the statements of previous investigators, as THOMPSON and WHITTIER,[3] BROWNE,[4] and WORCOLLIER,[5] the results obtained show very clearly that levulose is always the predominating sugar, exceeding in fact the combined amounts of the other sugars present. Thus, the levulose was found to vary from 5·0 to 7·2; the dextrose from 1·4 to 3·5; and the sucrose from 0·8 to 4·6 per cent. Browne's method gave somewhat higher results than that of Thompson and Whittier.

SEPARATION AND IDENTIFICATION OF FOOD COLOURING SUBSTANCES. *W. E. Mathewson.* *U.S. Department of Agriculture, Bulletin, No. 448, Professional Paper, February 15th, 1917.*

The scheme of analysis of dyes described in this bulletin embraces about 130 chemical individuals, comprising practically all those coal-tar colours which have been mentioned in the literature as having been found in food products and suitable for the colouring of foods. The method of separation is based mainly upon the employment of immiscible solvents, by which most mixtures of the commonly occurring coal-tar dyes may be isolated with relative ease. Although the most important natural colours have been included in the tables, little attempt has been made to indicate means of separation other than by the methods more suitable for synthetic dyes.

J P. O

---

[1] *Delaware College Agricultural Experiment Station Bulletin*, 102, 1913.

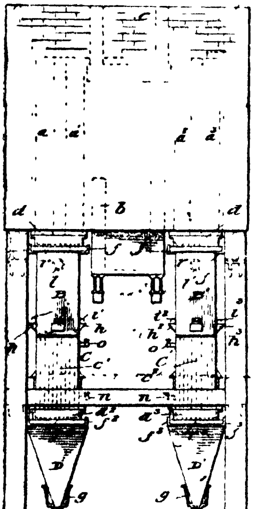
[2] *Jl. Amer. Chem. Soc.*, 1906, 28, 432. [3] Ibid. [4] Ibid. [5] *Ann Fals*, 2, 425-427

Review of Recent Patents.[1]

UNITED STATES.

Revivification and Decarbonization of Animal Charcoal (Bone Black) and its Substitutes.[2] *Moriz Weinrich. 1,184,398.* Patented, May 23rd, 1916.

The apparatus comprises a double row of kiln retorts, a, a^1, a^2, a^3, etc., the number of which may average about 80, these being enclosed in the brickwork A, A^1, retained above the cooling chambers C, C^1. There is a suitable furnace b arranged between the innermost of the double row of retorts for heating the material to the desired degree. Underlying the retorts are distributing chambers d, d^1, each of which has an airtight connexion with two rows of the retorts a, a^1, a^2, a^3, etc. They extend the whole length of the kiln, and are 6–10 in. high, so that the char or other material being treated discharged from the retorts will completely cover the bottom of the chambers. The bottom of the chambers d, d^1, is perforated, either by slits or preferably by circular openings, which are just large enough to allow the free passage of the char. Closely fitting under the bottom of each of the chambers is a planed perforated plate, whose perforations are approximately the same as those in the bottom plate of the chamber, which plate is supported at its edges by horizontal guides. Between these guides the plates may have a reciprocal or to-and-fro movement imparted to them by an eccentric g, or other means.



The arrangement of the aforesaid plates is to discharge in a regulated way the filtering material, which shifts through the perforators at the bottom of the distributing chambers, d, d^1, and through plates, in the form of a^1 shower of thin streams. The perforations in the plates are designed to register with the perforations in the bottom of the chambers so that by a movement in one direction, about one-half of the perforations will be in register with corresponding perforations in the bottom of the chambers, and by the movement, in an opposite direction, the other half of their perforations will be in register with those in the bottom of the chambers. Thus the filtering material will fall practically continuously through the perforations during the operation of the apparatus.

Between each of the distributing chambers d, d^1, and the cooling portion C, C^1, of the apparatus, are interposed the closed chambers B, B^1, which may be constructed of suitable metal and may be from 4 to 6 ft. high, more or less, and have a width and length about equal to the distributing chambers b, b^1, and from which distributing chambers the bone-black, or other filtering material, is delivered to the cooling chambers in the form of many thin streams. The closed chambers B, B^1, are the oxydizing or decarbonizing chambers, and in the construction shown they are provided at one end and, if desired, at the sides, with one or more air vents h, h^1, h^2, h^3, etc., which are situated, in practice, about one foot above the bottom of each of the chambers, each of the vents being about one foot wide and about six inches high, and each being provided with a sliding shutter i, i^1, i^2, i^3, etc., for preventing the filtering material from flowing out in case it should accumulate too high on top of the pipes c, c^1, with which the cooling chambers are provided, and which pipes are surrounded by a cooling medium. In addition to the vents, each of the oxidizing chambers is provided near the top of the same, with an air vent l, l^1, which is in turn connected with a flue connected either with a flue leading into a drier or to a fan or other device, not shown, the said flue being provided with a regulating damper, m.

---

[1] Copies of specifications of patents with their drawings can be obtained on application to the following:—*United Kingdom:* Comptroller of the Patent Office, Southampton Buildings, Chancery Lane, London, W.C. (price, 6d. each). *United States:* Commissioner of Patents, Washington, D.C. (price 5 cents each). *France:* L'Imprimerie Nationale, 87, rue Vieille du Temple, Paris (price, 1 fr. 05 c. each). The date given in the heading of United Kingdom specifications is that of the application of the patent.

[2] The Agents for this patent for Great Britain and her Colonies are The Sugar Manufacturers' Supply Co., Ltd., 2, St. Dunstan's Hill, London, E.C.3, to whom enquiries should be directed.

The cooling chambers C, C^1, consist of a casing or shell in which the pipes c, c^1, of which there may be a large number, are arranged in upright position, with their upper ends communicating with the oxidizing chambers above, so that the filtering medium on leaving the oxidizing chambers passes through the water cooled pipes and has its temperature reduced to the desired extent. The cooling of the filtering material may be done either by water, admitted through a suitable inlet n, as shown in the drawing, in which case the whole cooler has to be inclosed, the cooling water entering continuously at the bottom through an inlet pipe n, the water thus entering the shell of the cooling apparatus and surrounding the pipe and flowing out through the pipe o, at the top. If desired, the pipes may be cooled by air, either with or without forced draught.

At the bottom of the cooling chambers are arranged other chambers d^2, d^3, which are similar in construction and arrangement to the chambers d, d^1, which underlie the retorts, a, a^1, a^2, a^3, etc. The lower ends of the cooling pipes communicate with and deliver the filtering material into these chambers d^2, d^3, the bottom of which have perforations similar to those formed in the bottom of the upper chambers b, b^1. The chambers d^2, d^3, have a close fit against perforated and planed plates r^2, r^3, which are slidably mounted in guides f^2, f^3, and each of the plates are designed to be moved to and fro by an eccentric p, in substantially the same manner as described for the plates r, r^1, whereby the discharge of the cooled filtering material will be the same as that being discharged from the distributing chambers d, d^1, above. The cooled material is in turn delivered directly into suitable hoppers D, D^1, which underlie the cooling chambers and which preferably have downwardly converging walls and each hopper having an outlet controlled by a suitable gate or valve, g, for regulating the discharge of the revivified bone-black or other cooled filtering material, which may finally be delivered from the hoppers D, D^1, upon an endless travelling belt, or other conveyor E, the material being now in condition for re-use.

From the foregoing it will be readily understood that the operation of the apparatus described is substantially as follows: The char or other filtering material is heated in the retorts a, a^1, a^2, a^3, etc., or in any other suitable vessels having air-tight connexion with the distributing chambers d, d^1, so that the retorts, as well as the chambers, are always filled with material. When treating char its temperature should be brought to about 900° F. (680° C.), for simply revivifying, and to about 1100° F. (590° C.) if simultaneously one-half to one per cent. of carbon is to be removed. The temperature is regulated by the fire in the furnace b, and this can be ascertained by a pyrometer inserted into the wall of the oxidizing chamber B, or otherwise. The material heated to the desired temperature by the plates r, r^1, is caused to fall practically continuously in the form of many thin streams and in this condition the material passes through the oxidizing chambers b, b^1, in each of which is maintained a regulated draught of atmospheric air through the air vents h, h^1, h^2. h^3, etc., and the flue m. While falling through this draught of air in a shower, every particle of the hot material will be hit by the air, causing thereby the desired oxidization of the heated impurities retained by the char or other material under treatment, and, also, of a certain amount of any excess of carbon. The char should be allowed, before the discharge from the coolers C, C^1, into the hoppers D, D^1 begins, to accumulate about six inches on top of the cooling pipes. As all of the pores of the hot particles of char have been filled with air, while falling through the draught of air, the oxidization of the impurities will be finished while the hot material is lying on top of the cooling pipes. In this way, all of the impurities will be oxidized and carried off in gaseous form by the draught of air leaving thereby the pores always free, avoiding any accumulation of carbon, which will occur with ordinary kiln work, choking greatly the pores and reducing greatly the decolourizing efficiency.

Since the temperature of the bone-black has to be brought only to about 900° F. (680° C.) for revivifying, while with ordinary kiln work it has to be brought to about 1200° F. (650° C.), and maintained at this temperature for at least half an hour, it is obvious that by the use of the apparatus not only the pores of the filtering material will be kept always clean and highly efficient, but also the capacity of the kilns will be greatly increased, much fuel saved, and the life of the retorts prolonged, owing to the mildness of the heat applied.

UNITED KINGDOM.

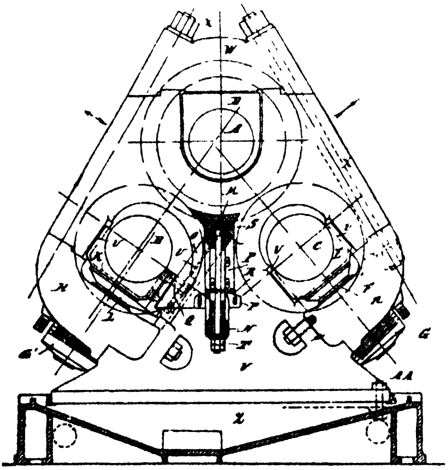
Cane Mill providing Automatic Regulation of Feed and Discharge Openings.

Société Anonyme des Ateliers de Construction de J. J. Gilain, of Tirlemont, Belgium. *100,945* (*9408* of 1916). Applied for, July 4th, 1916, Convention date, July 19th, 1915 (Belgium). Accepted, March 15th, 1917.

It is intended to provide a construction in which the openings between the rollers at the feed and discharge ends are regulated automatically independently of one another, and in which the space comprised between the trash-turner and the upper or head roller is also regulated automatically to the same degree and in the same direction as the opening between the feed rollers. Further, the invention has as its object a system of automatic regulation of the trash-turner with respect to the automatic regulation of the aperture between the feed rollers without the assistance of complicated gearing and without necessitating the employment of auxiliary controlling mechanism during the operation of the mill. The invention is characterized by the fact that the supporting bracket of the trash-turner is directly supported by the pressure blocks of the lower feed roller, which are provided with two slides supporting the bracket upon which the trash-turner rests.

The head roller *A* rotates in the bearings *D*. The bagasse roller *C* is held in bearings *E* which are carried by the blocks *F* supported by hydraulic pistons located in the hydraulic cylinders *G*, which latter are screwed into the lower cover *H*. The feed-roller *B* turns in the bearings *K* resting upon the blocks *L* actuated by the hydraulic pistons which are located in the cylinders G^1 as is the case for the bagasse roller. *N* designates the supporting bracket carrying the trash-turner *M*.

As is shown in the figure, the axes of the hydraulic cylinders *G* and G^1 containing the hydraulic pistons supporting the blocks *F* and *L* are placed in oblique planes in which the forces are generated during the passage of the cane and the bagasse between the upper fixed roll *A* and the feed and bagasse rollers *B* and *C*, in such a manner that during the displacement of the rollers *B* and *C* their bearings and their blocks slide in their guides without having to overcome exaggerated friction. On the other hand the bracket *N* of the trash-turner is carried directly by the blocks *L* of the bearings of the feed-roller *B*. To this end the bracket is fixed by bolts *P* to two slides *O* placed right and left of the roll, and which are secured by bolts *Q* to the blocks *L*. The trash-turner thus forms, through the intermediary of the supporting bracket, a rigid whole with the supporting blocks of the bearings of the feed-roller. This enables the trash-turner to move with the feed-roller during the operation of the mill and precisely in the same direction and to the same extent as this roller without its being necessary to effect any regulation during the operation of the mill and without the necessity arising of arranging any complicated transmission movement between the bearings of the roller and the trash-turner to compel the latter to take part in the displacements of the feed-roller.

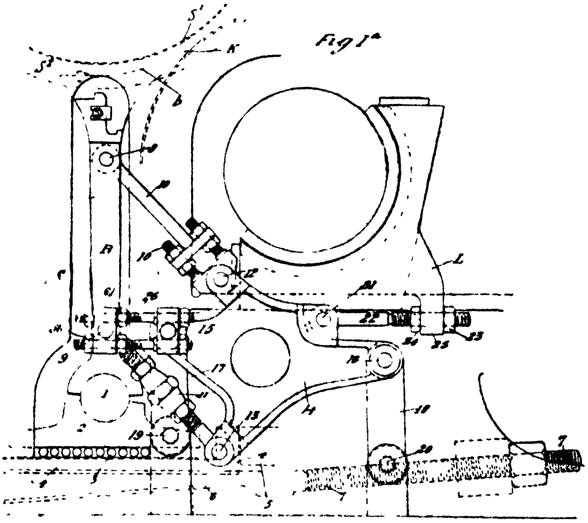


The regulation of the aperture between the upper or head roller *A* and the trash-turner *M* is effected when the mill is at rest, no subsequent regulation during the operation being necessary by reason of the complete solidarity of the movements of the roller and of the trash-turner. To permit of this regulation when the mill is at a standstill the holes made in the bracket *N* for receiving the bolts *P* are made oval, which permits of slightly raising and lowering the bracket with the trash-burner and of putting plates *R* between the bracket *N* and the slides *O* according to the space which it is desired to provide between the upper roller *A* and the trash-turner *M*; it is then only necessary to tighten the bolts *P*.

In order to effect the regulation in the horizontal direction, when the mill is at rest, use is made of the wedge-key *S*; after the trash-turner *M* has been adjusted horizontally it is fixed upon the bracket *N* by means of the bolt *T*. The bearings *E* and *K*, as also the intermediate slides *O* of the bracket *N*, rest upon the supporting surfaces *U* of the main frame *V*. These surfaces *U* are situated, like the axes of the hydraulic pistons, in the direction of the forces which act upon the rollers, that is to say, approximately in the direction of the lines which connect the centre of the upper roller *A* to the centres of the feed and bagasse rollers *B* and *C*. The lower covers *H* and the upper covers *W* are fixed upon the vertical frames *V* by means of strong bolts *X* placed approximately in the direction of the forces acting upon the rollers. The vertical frames *V* are fixed over the juice trough *Z* by means of bolts *A*.

CANE MILL WITH ADJUSTABLE BAGASSE BRIDGE. *Gustav Nicolai*, of 100, Klattauerstrasse, Pilsen, Bohemia, Austria. *10,876.* Applied for, July 27th, 1915. Convention date, July 29th, 1914. *Grant of Patent suspended.*

In this type of mill, having hydraulic pressure compensation for the top roll, or the two lower ones, the bagasse-bridge is so arranged that it can be adjusted for varying feed during running, the cutting edge being pressed against the second roll, and the predetermined ratio between the feed and the discharge gaps maintained constant. The roll bearings are also formed with spherical surfaces.



In the figure which shows the arrangement when the hydraulic compensation is applied to the top roll, *B* denotes the bagasse-bridge. The edge *K* of the cutting blade scrapes the cane under treatment from the feed roll, whereupon the material is conveyed along the face *B* of the cutting blade between the upper and the discharge rolls. S^1 and S^2 are respectively the feed and discharge gaps of the face, and in order to ensure a proper operation of the mill, the widths of these gaps must be in constant ratio to each other, which ratio will vary according to the quality of the cane being crushed.

The support *B* for the bagasse-bridge is mounted in bearings *1* at each end so as to be capable of horizontal movement by intervening connexions and screw *22*, and vertical movement by the wedge *6*, the cutting-edge *K* being maintained in contact with the roll by means of the parallel links *10*, *11*, one of which *11* is adjustable in length. In the form in which the hydraulic-pressure compensation is applied to the lower rolls, the lower bearing *1* of the bridge *B* is replaced by an eccentric arrangement of shafts adjustable by a pawl and lever, the lower link of the parallelogram being changed to an adjustable link connected between one eccentric and the horizontal adjusting screw on the bearing of the first lower roll. The bagasse-bridge is adjustably mounted on its support, by means of set-screws and may have an hydraulic compensator. The bearings for the rolls are provided with bushes shaped to receive bearings the outer faces of which are spherical, the centre of the sphere being the axis of the roll, so that the rolls can adjust under the pressure obliquely without throwing undue strain on the bearings.

PHOSPHATIC MANURES. *General Chemical Co.*, 25, Broad Street, New York, U.S.A, (Assignees of *F. W. de Jahn*, of same address) *104,682* (*3228* of 1916). Applied for, March 5th, 1916. Not yet accepted.

A mono-calcium phosphate or phosphoric acid, for instance, produced by treating a phosphate rock with an acid, as nitric or hydrochloric acid, the calcium salt of which is soluble, is treated with ammonia in the presence of a soluble calcium salt, the ammonia being used in such quantity as to convert the phosphate into the corresponding di-calcium salt. The whole mixture is then dried. In an example quoted, the calcium phosphate rock containing calcium carbonate is treated with nitric acid, and aqueous ammonia is added. Reference is made to specifications 1040 of 1857, 879 of 1859, 1420 of 1871, 18,324 of 1891, and 20,885 of 1904.

INSECTICIDES IN COMBINATION WITH COLLOIDS AS GLUE. *G. L. Lemmens*, of Linden's, Wateringbury, Kent; and *P. J. Fryer*, 12, Pembury Road, Tonbridge, Kent. *105,478* (*9863* of 1916). Applied for, July 13th, 1916.

Concentrated preparations of insecticide to be used after dilution with water and containing arsenical compounds as the active principle are made into a composition of the consistency of cream by the addition of colloids, as glue, starch, gluten, alkali soaps, compounds of resin with alkalis, gum arabic, gelatine, and albuminous materials. The colloid has a quasi-mechanical effect tending to hold the arsenical compound evenly in suspension when dilution takes place, and to prevent rapid settling and agglomeration, whereby the strength varies rapidly.

UNITED KINGDOM APPLICATIONS.

DISTILLATION OF ALCOHOLIC LIQUORS IN MULTIPLE EFFECT. *Société E. Barbet et Fils et Cie.* *9465-9466.* June 30th, 1917. Under International Convention, France, June 9th, 1914.

MANUFACTURE OF DECOLORIZING CARBON. *Ensuiko Sugar Manufacturing and Development Co., H. Miyake, and Y. Okadu.* *9248.* June 27th, 1917.

CONTINUOUS RECTIFICATION OF ALCOHOLS. *Société E. Barbet et Fils et Cie.* *9659.* July 4th, 1917. Under International Convention, France, October 19th, 1914.

MANUFACTURE OF SUPERPHOSPHATE. *J. G. Ledwidge and C. McKenny.* *9966.* July 10th, 1917.

HEATING OF CONCENTRATION SOLUTIONS. *W. H. Taylor.* *10,144.* July 13th, 1917.

APPARATUS FOR INDICATING DEPTH OF LIQUID IN TANKS. *Foster Engineering Co. and R. I. Bagnall.* *10,464.* July 20th, 1917.

SYRUP FILLER. *R. Beaumont.* *10,528.* July 23rd, 1917.

MANUFACTURE OF DECOLORIZING CARBON. *H. M. Shilstone.* *10,759.* July 26th, 1917. Under International Convention, United States, May 31st, 1917.

Sugar Crops of the World.

(Willett & Gray's Estimates of Crops to July 19th, 1917.)

	Harvesting Period.	1916-17. Tons.	1915-16. Tons.	1914-15. Tons.
United States—Louisiana	Oct.-Jan.	271,339	122,768	216,696
Texas	,, ,,	6,250	1,000	3,500
Porto Rico	Jan.-June	450,000	431,337	308,178
Hawaiian Islands	Nov.-July	575,000	529,895	577,186
West Indies—St. Croix	Jan.-June	12,000	14,750	4,500
Cuba, *crop*	Dec.-June	3,000,000	3,007,915	2,592,667
British West Indies—Trinidad	Jan -June	65,000	64,231	68,822
Barbados, *exports*	,, ,,	55,000	65,000	32,578
Jamaica ,,	,, ,,	15,000	15,143	15,063
Other British West Indies	,, ,,	30,000	30,000	24,000
French West Indies—Martinique, *exports*	Jan.-July	40,000	39,925	38,581
Guadeloupe	,, ,,	40,000	34,111	39,617
San Domingo, *exports*	Jan.-June	150,000	126,058	108,267
Mexico, *crop*	Dec -June	50,000	65,000	110,000
Central America	Jan.-June	35,000	35,000	36,275
South America—				
Demerara, *exports*	Oct.-Dec. and May-June	120,000	116,224	113,632
Surinam, *crop*	Oct.-Jan.	15,000	13,000	12,000
Venezuela	Oct.-Dec.	20,000	7,000	3,000
Ecuador	Oct.-Feb.	8,000	7,567	7,107
Peru	Oct.-Feb.	250,000	250,000	262,841
Argentina	June-Nov.	84,069	149,299	335,956
Brazil	Oct.-Feb.	225,000	194,000	240,000
Total in America		5,516,658	5,319,223	5,140,466
Asia—Brit. India, *crop* (consumed locally)	Dec.-May	2,626,000	2,634,000	2,460,573
Java	May-Nov.	1,596,174	1,198,567	1,303,045
Formosa and Japan, *crops*	Nov.-June	436,026	405,227	262,000
Philippine Islands, *exports*	,, ,,	170,000	332,158	243,000
Total in Asia		4,828,200	4,569,952	4,268,618
Australia (1917-18, 265,000 tons)	June-Nov.	175,000	159,681	246,408
Fiji Islands, *exports*	,, ,,	100,000	90,000	102,000
Total in Australia and Polynesia		275,000	249,681	348,408
Africa—Egypt, *crop* (consumed locally)	Jan.-June	110,000	100,000	75,738
Mauritius, *crop* (1917-18, 300,000 tons)	Aug.-Jan	208,000	215,528	277,164
Réunion, *exports*	,, ,,	45,000	45,000	39,267
Natal, *crop*	May-Oct.	125,000	112,000	91,619
Mozambique, *crop*	,, ,,	55,000	50,000	40,000
Total in Africa		543,000	522,528	523,788
Europe—Spain	Dec.-June	6,000	6,359	7,376
Total cane sugar crops		11,168,858	10,667,743	10,288,656
Europe— Beet sugar crops	Sept.-Jan.	4,764,449	5,077,760	7,583,215
United States— Beet sugar crop	July-Jan.	734,577	779,756	646,257
Canada— Beet sugar crop	Oct.-Dec.	12,500	17,641	13,979
Grand total cane and beet sugar	**Tons**	**16,680,384**	**16,542,900**	**18,532,107**
Estimated increase in the world's production	**,,**	137,484	....	....

United States.

(Willett & Gray, &c.)

(Tons of 2,240 lbs.)	1917. Tons.	1916. Tons.
Total Receipts January 1st to July 19th	1,755,013	1,899,678
Receipts of Refined ,, ,,	—	—
Deliveries ,, ,,	1,759,288	1,793,264
Importers' Stocks, July 18th	6,690	110,492
Total Stocks, July 18th	241,323	288,937
Stocks in Cuba, July 18th	610,977	597,390
	1916.	1915.
Total Consumption for twelve months	3,658,607	3,801,531

Cuba.

STATEMENT OF EXPORTS AND STOCKS OF SUGAR, 1914-1915, 1915-1916, AND 1916-1917.

(Tons of 2,240 lbs.)	1914-15 Tons.	1915 16. Tons.	1916-17 Tons.
Exports	1,603,891	2,152,840	1,984,751
Stocks	688,162	659,256	691,757
	2,292,053	2,812,096	2,676,508
Local Consumption	41,800	46,690	58,000
Receipts at Ports to June 30th, 1917	2,333,853	2,858,786	2,734,508

Havana, June 30th, 1917 J. GUMA.—L. MEJER.

United Kingdom.

EXPORTS OF SUGAR.

	MONTH ENDING JUNE 30TH.		SIX MONTHS ENDING JUNE 30TH.	
	1916. Tons.	1917. Tons.	1916. Tons.	1917. Tons.
BRITISH REFINED SUGARS :—				
Refined and Candy	150	99	3,521	618
Total	150	99	3,521	618
FOREIGN AND COLONIAL SUGARS :—				
Refined and Candy	107	—	637	7
Unrefined	482	56	543	382
Various Mixed in Bond	—	—	—	—
Molasses	16	5	557	17
Total Exports	**755**	**160**	**5,258**	**1,024**

THE

INTERNATIONAL

SUGAR JOURNAL.

No. 225. SEPTEMBER, 1917. Vol. XIX.

☞ **All communications to be addressed to "The International Sugar Journal," 2, St. Dunstan's Hill, London, E.C.**

Cheques and Postal Orders to be made payable to "The INTERNATIONAL SUGAR JOURNAL," and not to individuals.

☞ **The Editors are not responsible for statements or opinions contained in articles which are signed, or the source of which is named.**

The Editors will be glad to consider any MSS. sent to them for insertion in this Journal and will endeavour to return the same if unsuitable; but they cannot undertake to be responsible for them unless a stamped addressed envelope is enclosed.

Notes and Comments.

German Sugar and British Markets.

It seems at length to have dawned on the "Verein der Deutschen Zuckerindustrie" that the German sugar industry after the war may not be indispensable to the British sugar market, and that the latter may continue, as during the war, to supply its needs almost exclusively with tropical cane sugar. In an appeal to the German Chancellor the Verein, if reports from Amsterdam given in the *Times* are correct, express a desire for the continued existence of the Brussels Convention on the condition that England shall agree to it under the same conditions as in the first Convention. It is highly important in the interests of the German sugar industry, they declare, that cane and beet sugar should be placed on an equality as regards their import into England, in order that Colonial sugar may not permanently exclude beet sugar from the British market.

No doubt it is; but if the German Verein think that after the war we are voluntarily going to revert to the status quo ante bellum and admit German sugar on most favoured nation terms and be willing to tie ourselves down to the stipulations of the first Brussels Convention, which by its provisions precluded us from granting to our colonies any preference over Continental beet in our markets, they must be living in a fool's paradise as regards public opinion in this country. If there is one thing that it is fairly safe to prophesy, it is that after the war this country *will* give a preference in some form or other not only to our Dominions and colonies overseas, but also to our Allies, over and against the terms offered to our present enemies. So the first Brussels Convention may as well be relegated to the limbo of the past.

Of course it is manifest that the ability of either party to carry out any given resolve is contingent on first winning the war; if the German Verein still think that their country will be in a position when peace comes to dictate the terms, then it is an obviously logical step for them to take now to prompt the Chancellor to get for them the same favourable market conditions as of yore. But fortunately for us present indications do not offer any real scope for maintaining such a belief; and we suspect that some day German trade and industry will get a severe shock when they begin to realize the extent to which the Allies propose to take action to thwart all German post-war trade ambitions. Meanwhile, it is interesting to learn the mind of the Verein on the subject of trade in sugar; it should drive the last nail into the coffin of the Brussels Convention, which was only an expedient to enable the United Kingdom to cling for a little time longer to her theory of "duty for revenue purposes only."

Plans for Imperial Trade.

As a matter of fact, in spite of being busy with the supreme task of getting on with the war, our Government are taking time by the forelock in the matter of having a thought-out policy of Imperial or Inter-allied trade when once peace returns. It will be remembered that in the Spring there was a series of meetings in London of an Imperial War Cabinet consisting of representatives of the Home and Colonial Governments[1] and dependencies, who not only discussed the problems of the day arising out of the prosecution of the war, but also debated the subject of Imperial Preference and unanimously accepted the principle that "each part of the Empire, having due regard to the interests of our Allies shall give specially favourable treatment and facilities to the produce and manufactures of other parts of the Empire." Now another stage has been reached by the decision of the Government (announced on August 14th) to appoint a Committee under the able presidency of Mr. WALTER LONG, the Colonial Secretary, to consist of ministers representing all the departments concerned, whose duty it will be to investigate and report on the best methods and machinery for giving effect to the above resolution of the Conference. The task, as Mr. LONG himself pointed out, is not made less difficult by the necessity of having a policy so framed as to meet the views of our Allies. These Allies, be it observed, are getting more numerous every year as one country after another finds Germany's aggressive tactics too intolerable to be borne; and the new Committee will not find it an easy job to reconcile all the claims, even if those who come in at the eleventh hour are not placed on the same footing as those who have borne the burden and heat of the day.

But it may be assumed that unless the Allies agree to a free trade union amongst themselves, a very unlikely contingency, there will always remain a right on the part of the constituents of our own Empire to obtain a preference over all others. The same view will almost certainly be taken by other States as regards their own possessions, and the only matter for debate ought to be as regards the extent of the preference.

Since the Allies' pact at Paris last year, which was aimed direct at enemy trade, there has been no later announcement as to what the modus operandi against the latter would be. But that will doubtless come in its own good time; opinion in this country is even firmer in its resolve to penalize enemy trade than it is to grant preference to Allies, and no Government which did not act up to this spirit would stand any chance of success. So we must bide our time and in the meanwhile get on with the war.

---

[1] All save Australia which was involved in an unfortunate political crisis and in consequence could not select a representative in time.

Capital and Labour in Queensland.

The cane sugar industry of Queensland has been passing through a time of trial the last few years, owing to the struggle between the employers and labour over the question of wages. Labour is very strong in Australia, and numerous arbitrations over rates of wages have been undertaken, the general trend being to grant wages on a scale which would be considered very high in this country, but in Australia is merely deemed a living wage. Some industries can doubtless bear the tax on capital, but others are not so fortunately placed, and it is clear that the sugar industry with all its vicissitudes of good and bad seasons is not one that can afford to pay in normal years a rate of wages which will make the employers' profits so moderate as to leave nothing in hand to cover the losses of bad years. Yet the Queensland planters have been called on twice within the last three years to grant increased rate of wages to the industrial workers, and the last award, made in 1916, was in their view so excessive that rather than incur almost certain losses they seem in many instances to have preferred to close down till an appeal to the Industrial Arbitration Court might result in a modification of the 1916 award. This appeal was heard in May and resulted in the planters obtaining some reduction in their liabilities in the matter of wages.

The first award, made in 1914, and generally known as the Macnaughton award, fixed the daily rate for sugar field workers at 8s. 8d. in the south and 9s. 2d. in the north. At that time the price of raw sugar was in the neighbourhood of £16 per ton but was subsequently raised to £18, and it was admitted by the growers' representatives that at the latter figure for sugar they could afford to pay the 1914 award wages. But in 1916 another award, known as the Dickson one, was made in answer to the further claims of labour, which fixed the rates of wages at 12s. 6d. and 13s. respectively. Meanwhile the price of sugar had gone up to about £21 per ton. This represented an extra gain to the grower of about 5s. per ton of cane; but the evidence given at the appeal in May last suggested that this gain was not quite sufficient to pay the increase in wages which was judicially declared to work out at about 5s. 6d. per ton.

No wonder, then, the Australian Sugar Producers' Association lost no time in appealing from the 1916 award. The appeal was heard by Judge McCAWLEY, in the Industrial Arbitration Court. The growers here contended that if the increased price of sugar did meet the extra wages, it was nevertheless unfair that the labourers should pocket the whole of the extra profit. If the workers' lot was to be improved, why should not the growers' lot also be? This argument did not, however, seem to receive due weight on the part of the judge, who (to quote the organ of the Australian Sugar Producers' Association[1]) "failed to grasp the distinction between the employer carrying all the risks and responsibilities of the industry, paying wages whether he wins or loses, and the employee who must be paid the fixed wage for every moment he works, even if—as often occurs—his labour should prove to be totally unproductive." Certainly it will be agreed by most economists that "the idea that the employer should only receive a certain percentage on his outlay, plus depreciation and interest, with allowance for his personal exertions, seems altogether to exclude the necessary principle that if he is to live and prosper in the industry, the good years must make up for the bad. In other words, after paying a fair and reasonable wage, he will need all that remains in the enterprise to cover losses and risks."

However, it has to be borne in mind that the task of the judge under the provisions of the Industrial Arbitration Act was virtually confined to arriving at the right figure for a living wage for the employees, and considerations of the employers' rights were unfortunately but a secondary issue. Still the terms of the award (which is to hold good for twelve months on the supposition that sugar will for that period not fall below £21 per ton) have gone rather in favour of the cane growers, inasmuch as the excessive rates under the Dickson award have been reduced by 4d. per day in the north, 1s. in the centre, and 1s. 2d. in the south of the sugar cane belt. In addition, a number of modifications have been effected in the employees' rights, such as regards feeding arrangements, which are to the benefit of the growers. Doubtless, the comment of the employers is: "For this relief much thanks." But doubtless too, the relief is only for a brief period, and all too soon the arguments will be thrashed out afresh.

---

[1] *The Australian Sugar Journal*, to whom we are indebted for the report of the case.

Meanwhile they have the additional recompense of what looks like a record harvest in Queensland. Over 300,000 tons of sugar are expected to be produced. Some of it is due to standover cane from the previous season, the result of labour difficulties; but the growing season has been an excellent one. Some of the mills, it is thought, may not be able to crush all the cane offered them before the end of the season. These include, for example, the new Government central, Babinda (a description of which appeared in our last issue).

Labour Problems after the War.

It is becoming increasingly probable that when the present military war is over and peace is restored, a great industrial upheaval will threaten all over the world, and will need the most skilful handling if trade paralysis is not to ensue. The reasonable demand on the part of workers for a living wage will have to be granted; but the difficulty will be to fix it so that the claims of capital to be reimbursed for the risks of industry can be adequately met. Then there are the unreasonable claims of ignorant sections of labour to be countered. If reports are correct, the Russian revolution was followed by the most outrageous demands on the part of the liberated workers for wages on a scale that would have involved the closing of all industrial factories, since these could only have been worked at a loss. Success will depend in fact on the prevalence of moderating counsels and on the suppression of the claims of extremists of either party.

The levelling up of the wages of the worker is proceeding also in the United Kingdom; the most noteworthy advance of late has been that of the agricultural labourer, who a decade or less ago was thought to be well recompensed on 12s. or thereabouts a week. He is now to have a minimum of 25s. per week, while his employers, the farmers, are to have a minimum price guaranteed for their cereals. Comparison of this sum with that of the Australian award suggests that even allowing for the higher costs of living in the Commonwealth, the Queensland labourer is doing considerably better than his colleague in the old country.

A Substitute for Indentured Indian Labour.

The long established system of indentured Indian labour which has held in our Crown colonies in America has for some time past been the object of strong criticism on the part of Indian leaders, and the Indian Government were led to the conclusion that a change would have to be effected in the system if further emigration from India was to be allowed. They consequently announced their intention to prohibit the indentured system, but delayed putting the veto into force till time had been allowed the authorities to devise an improved scheme for Indian immigration into British Crown colonies.

Such a scheme has now been drawn up by an Inter-Departmental Commission of the India and Colonial Offices, presided over by Lord Islington. It is intended to be an improvement on the old system in that it will give Indians more freedom, will encourage their settlement, after a probationary period of employment, in the colonies, will tend to train and fit them for the new conditions of life there, and at the same time provide the supply of labour essential to the carrying on of the tropical agriculture with which the success of these colonies is bound up.

The colonies concerned are British Guiana, Trinidad, Jamaica, and Fiji, whither indentured labour has gone in the past. Under the old arrangement, the Indians were indentured to labour for a term of years for a given employer, and then had to go back to India failing their qualifying as settlers. The new arrangement will give the immigrant greater freedom ; except for a six months' period of probation when he arrives, during which time he will undertake work for selected employers, he will be free to stay on or return home as he chooses. Having passed his probation, which will have initiated him into the ways and life of his new surroundings, he will also be free to change his employers as he pleases subject to a month's notice ; at the same time he will be encouraged to work for agriculture for at least 2½ years longer by the offer of subsequent benefits in the shape of land on which to settle as a colonist. If he desires instead to be repatriated, he will be assisted by a proportion of the passage money being granted him, depending on the time he has spent in the colony. Thus after seven years' continuous residence he will get a free passage. But the acceptance of a settlement will extinguish any claim for assistance to return to India. It is to be noted that the emigration of whole families (not merely of labourers) is to be encouraged, and especially of families containing unmarried women who may serve to become the wives of other Indian immigrants in the colonies. Thus the Indians will have an additional incentive to settle down in their new surroundings and become colonists, and help to develop the natural resources of the colonies to the benefit of the Empire generally.

This new arrangement will come very opportunely as a means of providing an increased supply of reasonably cheap labour for extending the sugar production of our Crown colonies. British Guiana, for instance, may thereby be better enabled to develop her vast hinterland. Cane sugar is essentially a tropical product, and in spite of Queensland's attempt to prove the contrary, it is not practicable to produce it by means of white labour alone. But a contented Indian population which is able to "better itself" in the colonies, as compared with existing in extreme poverty and semi-starvation at home, will offer the industry the necessary means for producing at competitive prices one of the world's staple food crops. Without this aid the labour problem would be an extremely difficult one, and the question of extension would receive no early solution.

At the moment of writing, it is too early to learn what public opinion in the colonies thinks with regard to the new arrangement; but while it is clear, that since the change is made at the instigation of the Indian Government, it may mean some slight sacrifice on the part of the colonies, yet the ultimate benefits to the latter are bound to exceed any small inconveniences that the cancellation of indentured labour will immediately produce; and the new spirit of reciprocity which the war has engendered throughout the Empire will almost certainly approve of this step to extend the freedom of race to the Indian elements.

Introduction of the Uba Cane into Jamaica.

The Uba cane, so generally cultivated in the South African sugar industry, has recently been introduced into Jamaica, on the recommendation of the present EARL KITCHENER, who as Colonel KITCHENER was well known in the island. A former Jamaican planter who is now domiciled in Zululand was asked to send a consignment of this cane to the Hope Botanical Gardens, Jamaica. His first attempt to ship some via Durban was held up for some unknown reason at that port, but he finally succeeded in getting three cuttings through by parcel post, though even these suffered immersion in sea water in the mails en route. Two of the cuttings were dead on arrival, but the third still showed signs of vitality and was planted and tended, and in due time produced stools of cane which have been propagated. Doubt is expressed as to whether the Uba will ever take the fancy of the estate owner in Jamaica, but it may prove a useful cane for small growers in wet upland districts.

As regards its nomenclature, the Superintendent of the Jamaica Botanic Gardens, Mr. W. HARRIS, in his annual report gives some interesting conjectures. The Kew Bulletin, he says, points out that it was due to the late Mr. JOHN MEDLEY WOOD, D.Sc., A.L.S., who was for many years Curator of the Natal Botanical Gardens, that the Uba cane became established in South Africa. It is stated that the correct name of this cane is unknown; the name "Uba" represents the only letters decipherable on the damaged label attached to the variety on its arrival in Natal. Mr. MEDLEY WOOD thinks that the plant was introduced by the Acting Governor, Sir CHARLES MITCHELL, on his return from a visit to India in 1885. The word "Uba" may be part of the name "Bo*ub*aya" applied to one of the Madagascar canes introduced to the Mauritius Botanic Gardens by Dr. J. V. THOMSON in 1815. This name may have found its way to India from Mauritius along with the canes sent by Captain DICK in 1827 to the Calcutta Botanic Gardens on behalf of Captain SLEEMAN. From the cuttings of the canes, planted by SLEEMAN at Jubbulpur the cultivation of Mauritius canes gradually became established in the Deccan and had reached Bombay in 1838. But if the presence of the word "Uba" in Natal be due to the survival of the name "boubaya" in India, that name must now connate a cane unlike the one to which it was originally applied. According to Dr. THOMSON, the "boubaya" from Madagascar resembled an Otaheite cane.

Female Labour in Refineries.

One striking outcome of the war has been the extent to which women have been taking the places of men in labouring operations. There are few operative tasks into which they have not made an entry. The only limit has been one of strength; non-congeniality of task has not been a bar.

The British Home Office has issued a series of pamphlets dealing with the substitution of women in industry for enlisted men; different industries have been separately examined and reported on. One of these now before us relates to sugar refineries. Before the war, women's work in such establishments was confined to the lighter warehouse work, but since 1915 they have been suitably and usefully employed in a number of other operations; certain departments are still, however, considered undesirable for them. Much of the work is wet, heavy and hot, so only women of good physique can be profitably employed; but their work is facilitated by the use of mechanical aids which obviate the necessity of lifting heavy weights. Inclined planes and automatic elevators and conveyors, when properly arranged, make it possible for women to fill and help load heavy casks weighing 3 cwts. or more.

Of the processes now open to women the following gives some idea. Women wheel, cut open, and assist men in emptying bags of raw sugar; wash casks; charge, wash, and scrape the centrifugals where they are provided with open bottoms (men do the heavy lifting and scraping); charge the char kilns; attend the centrifugals in the cube-house, mind the cutting machines, and remove slabs from moulds; take samples in the filter-house; do the labouring work in the melting and mixing-house processes; and act as assistants in the unskilled parts of the vacuum pan department. Women also undertake the making of the boxes in which they pack the sugar, including the printing of these boxes, wash the filter cloths and the raw sugar bags, make small casks, and even clean the flues and stokeholds. Finally, there is scope for educated women in the research department of the laboratory, while the routine work of the laboratory is of course within their province. Altogether the employment of women in British sugar refineries has become of an extensive character. How far it will continue after the war is a problem which will have to be faced generally in all industry, and regarding which no concise solution has as yet been put forward. It is fairly certain however that after the war there will be, assuming there are enough men available, some pronounced clashing of sex interests, as men will insist on assuming their old positions, while employers—not to mention the women themselves—may prefer the continued practice of women labour in certain branches of industry.

The Kelham Sugar Beet Estate.

We learn that Mr. Sidney Colyer, of Ewhurst, Sussex, has been appointed by the British Sugar Beet Growers Society, Limited, as manager of the Kelham Estate, Newark, the object of which is to develop a large farm for the production of sugar beet as its main crop. Mr. Colyer was one of the thirteen original students of Wye Agricultural College, being there under Mr. A. D. Hall, from 1894 to 1897. He left with the College Diploma (with honours in Biology) and also holds the first-class certificate of the Royal Agricultural Society. From 1897 to 1905 Mr. Colyer occupied responsible managerial positions in Kent and Surrey. In 1905 he became again associated with Mr. Hall in the development and management of Messrs. Arthur Guinness, Son & Co., Ltd.'s experimental hop farms in Sussex, of which from 1911 he has had the entire management. It is clear from this that the Society has selected an expert agriculturist for the new post, though it is not so clear as to what experience he has had in sugar beet cultivation.

Mr. George M. Rolph, general manager of the California and Hawaii Sugar Refining Company of San Francisco, has been appointed chief assistant to Mr. Hoover, the American Food Controller, and will take on the task of regulating the work of the sugar department of the new food administration.

In a survey of the food supplies Mr. Lloyd George lately gave to the House of Commons, he stated that the sugar stocks at the beginning of the year were very low and continued to be very low throughout the spring. Sugar ships has singularly bad luck, there being probably a higher percentage of loss amongst them than amongst those carrying any other food commodity to these shores. But since then there has been a very material improvement, and there is an increase in our reserves, so the anxiety with regard to the sugar supplies is less now than it was six months ago. Meanwhile the sugar ration is maintained at ½ lb. per head per week.

The Defence of Industry.

V.

Fiction versus Truth.

One of the most striking, and at first sight incomprehensible, facts in the history of sugar and the sugar bounties is the universal prevalence of persistent assertions which will not bear the test of intelligent investigation, but which, nevertheless, not only continue to be made but, alas, continue to be believed by the man in the street. It is absolutely necessary to look further into this remarkable anomaly, because it is now evident, and even, it may be said, universally agreed, that in future our British industries must be defended against the State-aided attacks of foreign competitors if Britain is to hold its own in the troublous times that are upon us. We must define distinctly the nature and extent of the false assertions which have been made, during the last forty years, by those who opposed all efforts to defend the sugar industries of the British Empire against a deadly attack, and we must endeavour to understand why our opponents were quite content to have recourse to fiction when facts were dead against them, and why this ignorant public accepted the fiction and rejected the facts.

This last question, with regard to men's preference for fiction, has been admirably answered, curiously enough, by one of our most persevering opponents. Sir Edward Grey (now Viscount Grey), speaking at a gathering in Manchester in 1912, said:—"It is not difficult to tell the truth; the difficulty is to get the truth believed. It is quite easy to get something which is not the truth believed. Anybody can do that; it is so common to all human nature to prefer to believe that which is exciting rather than that which is soothing."

Nothing could be better than this explanation of the policy of our opponents, in trying to stop any relief to the troubles of the sugar industry, by using fiction when facts were against them, and in finding, to their delight, that interesting fiction was devoured with much more avidity than dry facts by those who were supposed to be searching for the truth.

Our minds at once revert to the outstanding instance, in the forty years' struggle of truth against fiction, of the assertion that abolition of the sugar bounties would raise the price of sugar. It was of no use to explain that the bounties only depressed prices in one way, namely, by stimulating excessive production, and that it was only when over-production had so far glutted the market as to force prices below the cost of production that the consumer enjoyed any advantage from the bounties. But that was only a fleeting benefit, because all other sugar producers were at once discouraged from producing at a loss, and consequently supplies began to be reduced and prices rose. That alternate process was bound to continue so long as the bounties stimulated production in the area of the bounty-fed industry. The result would be (and in fact was) that at each fluctuation between high and low prices the bounty-fed industry grew nearer to a monopoly. It actually did at last attain to producing more than half the visible production of the world. This again operated in the direction of raising prices periodically, because every time that there was a bad season in the bounty-fed European beetroot districts a large reduction in the crop, which supplied more than half the world's visible consumption, inevitably caused a very serious rise in price. For these reasons it was clear (to those who cared to think) that although the bounties at times might force prices for a few months below cost of production, the other two factors in their influence would so far disturb normal conditions in the opposite direction, by causing a (sometimes very violent) increase in price, that it was quite possible, and certainly probable, that the consumer in the long run would be no gainer, and might be a serious loser, in the matter of the price of sugar.

Every event in the history of sugar, since bounties were invented, has proved the truth of this forecast; but the old bald assertions, first, that the abolition of the bounties *would* raise the price of sugar, and secondly, that the abolition of the bounties *has* raised the price of sugar, are still believed by the majority of men in the street.

For the sake of British industries in the future, which must be defended if Britain is to survive, it is absolutely necessary to establish, once for all, the fact that what is called the whole system of the commercial policy of this country is based on a most dangerous fallacy, namely, that duties must be levied for no other purpose than that of revenue. This can be done only by exposing the ridiculous fictions to which the teachers of that most erroneous doctrine were obliged to resort when facts failed them. It may well be asked, why did politicians stick so tight to this doctrine when the practical experiences in the case of sugar proved it to be erroneous? It is to be feared that the true answer must be that the policy—erroneously called "Free Trade"—was such a good party cry that it must be defended by fiction when facts are against it. Our duty is to prove the truth of our assertion by a careful analysis of the various fictions which have been invented during the fight. This is necessary if we are to start afresh when the period of "reconstruction" arrives. We must "do our bit" towards giving the *coup de grace* to all false doctrine in the economic world if we are to reach safety for that fresh start.

That our sham free trade has been a glorious political cry is well proved by the experience in the struggle against the sugar bounties. So good was the cry that the opposite party, who would have gladly come to the rescue to save the sugar industries, dared not speak out—much less act. It is true that LORD SALISBURY desired people to clear their minds of cant, but he did not dare to go further. Mr. GLADSTONE also, as proved by our recent quotations from his utterances on the subject, was manifestly in our favour, but he dared not offend the worshippers of the fetish. It was not till Mr. CHAMBERLAIN, in his post at the Colonial Office, saw to his horror the sad condition of our West Indian Colonies that he, with his usual courage, spoke out plainly and backed his words with action. He spoke out bravely in 1899, in his great speech on the occasion of the Indian Tariff Bill debate, when he got the House of Commons to establish the principle of a duty to countervail a bounty. He boldly said:—"I trust this debate will result in a clear issue and a decision, by an undoubted and overwhelming majority, which will give the opinion of, at all events, this Parliament, in regard to the question of principle." He got his overwhelming majority, and India levied a countervailing duty. This led up to Mr. CHAMBERLAIN'S full admission, in 1903, of the right of British industries to be defended against State-aided attacks from outside. He was not supported by his party—they were afraid of the sham free trade cry. In a manly way he stepped aside and fought his own battle for the cause of British industries. His party wobbled, and blew sometimes hot and sometimes cold, but he persevered single handed till his wonderful strength broke down under the strain.

We must find someone to fight their battle again when the eagerly looked for (and by many dreaded) reconstruction is in sight. At present the duty of those who fought for real free trade in sugar is to expose, as we now propose to do, the shameful fictions with which our opponents bolstered up their bad case. We will examine most carefully these two audacious fictions, first the bold prophecy that the abolition of the bounties *would* raise the price of sugar, and, secondly, the impudent assertion that the abolition of the bounties, in 1903, *had* raised the price of sugar.

We all recollect the prophecy which emanated from the Cobden Club, or, we may say, from the Board of Trade, which in those days (1886) was the Cobden Club's Departmental incarnation. It declared positively and definitely, that the rise in price would cost the sugar consumers of the United Kingdom exactly eight millions per annum. The annual consumption was 1,600,000 tons; the bounty (they said) was £5 a ton; therefore—behold the loss!—1,600,000 multiplied by 5. This became the current argument with those who, in the sacred name of free trade, opposed freedom of competition for British industries in their own markets. The fiction was freely repeated, even by Cabinet Ministers.

But there is a much more audacious assertion even than this, because it is an assertion made in a printed document issued by the Board of Trade in June, 1880, and published in the Appendix to the Report of the Select Committee on Sugar Industries, dated August 4th, 1880. This paper, "handed in by Mr. Giffen" (of the Board of Trade), is entitled "Estimate of Gain to Consumers of Sugar in the United Kingdom since 1871 inclusive, by a Reduction of 2s. 6d. per cwt. in Price, owing to Foreign Bounties." Here we have, please note, not a mere irresponsible dream of an enthusiastic party politician, as in the former case, but a serious official statement, drawn up by the head of one of the most important and responsible Departments of the Board of Trade, and put in with a series of 17 other papers as statistical information which the Statistical Department of the Board desired to furnish to the Select Committee. This is probably one of the most curious documents ever produced and published by a Government department in this country. There is no circumlocution about it. It appears to be a plain statement of plain facts, and was no doubt accepted (as was intended by the inventor) as the plain truth when read or listened to by the ignorant and unsuspecting inquirer. It gives the figures of sugar consumed for each year from 1871 to 1879 in cwts., and having multiplied each of those amounts by 2s. 6d., gives in the other column, headed "Gain to English Consumer at 2s. 6d. per cwt." the millions sterling gained each year. The columns are then added up, and it appears that during the nine years the British consumer gained £18,095,303; not because the whole sugar consumed had received a bounty, though even in that case the figures would have had no foundation, but merely because the bounty to the Paris refiners had caused loaf sugar (a small portion of our total consumption) to be forced on our markets at prices with which our loaf sugar refiners could not compete. The profit of the sugar refiner depends on the margin between cost of raw and price of refined. If he gets more than, say, 1s. 6d. to 2s. per cwt. between the cost of the raw sugar he takes in and the price of *all the products he turns out*, including loss of weight, he makes a profit; if he gets less, he makes a loss. Therefore, if the foreign refiner who receives a bounty sells his products 3d. per cwt. below cost of production, he effectually shuts up his British competitor. The Board of Trade cared for none of these things. Details were negligible—even in the Statistical Department If the whole raw sugar out of which the sugar consumed in those days was made had been receiving a bounty, which was not the case, the consumer would have gained nothing until the price had been forced down by over-production below the world's cost of sugar production. That also was not the case during the period dealt with in the Board of

Trade statement. Again we see the authors of the statement were not even masters of the rudiments of the subject.

Now we come to the second fiction—this time a prophecy—namely that when the bounties are abolished there will be a permanent rise in price. Of course the two fictions are really the same fiction in two forms. If the consumer has gained £8,000,000 a year by the bounties he will lose that sum when bounties are abolished. We have shown why the first fiction must be a pure fiction ; but with regard to the second, with which we now propose to deal—so fully that it ought never to be able to raise its head again—we really have the hard facts of what has actually happened in the sugar market during the ten years since bounties were abolished. Probably even these hard facts will be disregarded by those people who prefer fiction. The fiction was universally believed by them at the time when Mr. CHAMBERLAIN made his great speech in the Indian Tariff Bill debate—but fortunately not by Mr. CHAMBERLAIN. He said very frankly that when he was at the Board of Trade he was under the influence of the Permanent Officials of that department, and that consequently he was led to believe in the predictions which he then made, "every one of which (he said) has been falsified by subsequent events." But though he might still believe in their facts and their statistics "never again (he declared) will I believe in their prophecy." He lived to see the final prophecy "falsified by subsequent events." We shall be able, with our longer experience, to give in black and white a complete contradiction to the audacious assertions (which, alas, still hold the field in political circles) first that the abolition of the bounties *will* raise the price of sugar, and, secondly, (a much more important declaration) that now, at this moment, it is an ascertained fact that the Brussels Convention, which abolished the bounties in 1903, *has* raised the price of sugar. It is not very long ago that a white paper from the Foreign Office told us, in instructions sent to the British Delegate to the Permanent Commission at Brussels, that a rise in the price of sugar then taking place, (well known in the market to be caused entirely by a short beetroot crop) was caused by the Brussels Convention.

A still more audacious assertion is quoted by Mr. SANDBACH PARKER in a paper recently published by "The British Empire Producers' Organization," entitled "The Sugar Supply of the Empire: its Production and Distribution." At page 19 we learn that Mr. HOBHOUSE, in 1912, at that time a member of the Government, said, in a speech at Derby, that "the Conservatives gave them to understand that the Convention would certainly keep down if it did not diminish the price of sugar, *but sugar had risen ever since.*"

Let us look now at the facts. Far from sugar going up when the Convention came into force, in September, 1903, it actually went down, for the very simple and manifest reason that there was too much sugar. We have before us the weekly quotations for the market sugar standard called "German Beetroot sugar, basis 88 per cent. net analysis, free on board Hamburg." To judge of the meaning of the prices we are about to quote it must be premised that the cost of production of sugar all over the world ranges from about 8s. per cwt. at the lowest to about 9s. 6d. to 10s. per cwt. at the highest, with, may be, a few exceptions of specially favoured localities, or seasons, or factories on the one hand, or of specially unfavourable conditions on the other. To strike an average we will take a figure somewhere between 9s. and 10s. per cwt. as the line between profit and loss in the production of good raw sugar. The figure has been inclined to rise since 1904.

With this preliminary explanation we will go through the figures for the 10 years 1904-13. In January, 1904, the price of the above-mentioned standard ranged from 7s. 10½d. to 8s. 3d.. In February prices remained below 8s. In March and April they were a shade higher, but at least 1s. below the cost of production. In May, June, and July, they were still below the cost of production, but in July serious fears were entertained about the coming beetroot crop. The fears were well founded, as was proved six months later when the crop deficiency turned out to be 1,200,000 tons—a most serious loss of supplies to satisfy the world's consumption. The only cure was a heavy rise in price. From 9s. 9d. in July, prices rose to 10s. 6d. in August, 11s. in October, 14s. 3d. in December, and 16s. in January, 1905, when the result of the crop was pretty well known and confirmed. "We told you so," cried the sham Free Traders, "this is the result of the Convention." Everybody believed them. No one, except those in the trade, knew that prices had remained for ten months after the abolition of the bounties below or round about the cost of production, and that a reduction of 1,200,000 tons in the world's supply of sugar was bound to cause a violent rise in price—of course aggravated by the usual interference, on such occasions, of the outside speculator. When he rushes to liquidate there is a general stampede, and prices fall. They fell from 16s. in January, 1905, to 11s. in July, and 8s. 9d. in August. This, therefore, could not have been a rise caused by the poor much-abused Brussels Convention, for here we were, just a year after the abolition of the bounties, with prices well below the cost of production. This story is the same for everyone of the short beetroot crops which occurred during the ten years since bounties were abolished. The opponents of the abolition of the bounties—all men who refused to allow British producers to enjoy free competition in their own markets—on each occasion shouted loudly, as before, that sugar was dear because of that wicked Convention. And then prices went down again to the old figure round about the cost of production—but they still shouted, and everyone believed them, and no one cared to take the trouble to look at the daily report of the sugar market. They believed, as Mr. HOBHOUSE wanted them to believe—that "sugar had risen ever since"—that is for nine years when he spoke those words. During the whole of the year 1906 the price hardly ever touched 9s., and for many months it was far below the average cost of production. During 1907 prices were very steady, between 8s. and 10s., again round about the cost of production. In 1908, with prices ranging from 9s. 6d. to 11s. 3d., there was only just room for some producers of raw sugar to work with a little profit. The crop of 1909-10 turned out to be deficient to the extent of about 500,000 tons, quite enough to cause a rise in price. Consequently prices began to rise in August, 1909, to 11s. 6d., December to 12s. 6d., February, 1910, to 13s. 9d., March to 14s. 9d., remaining about that figure till the end of August. The rise, as usual, had brought consumption and production nearer together and had also, as usual, drawn upon invisible supplies, so that prices fell until they reached 8s. 9d. in October—once more below the average cost of production. The speculators had burnt their fingers. The crop of 1909-10 turned out to produce 6,136,911 tons—about 500,000 tons below its predecessor; but the crop of 1910-11 produced 8,105,126 tons, so it is not surprising that, in anticipation of such an increased production, prices fell below 9s. in October, 1910. They remained so until March, 1911, when fears for the crop 1911-12 began to appear, and prices rose gradually till they reached 16s. 6d. in November. Again the joyful cry was heard that the Brussels Convention had driven up prices most alarmingly. The real cause was that the European beetroot crop instead of producing 8,000,000 tons of sugar, as it should have done if weather had been normal, only produced 6,346,000 tons, a deficiency of nearly 1,800,000 tons. The rise was inevitable. It was because the bounties had stimulated production of beetroot sugar to such an extent as to make the world dependent on it for more than half its supply that the consumer suffered so grievously every time there was a bad crop and a sudden deficiency, which is bound to drive up prices. The high prices in all these cases, therefore, clearly traced their origin to the action of the bounties, not to their abolition. The public, on the other hand, were deluded by the constantly reiterated assertion that whenever there was a rise it was the result of the abolition of the bounties. Why?—no one could tell them—but they believed it and still believe it. The saying is no longer "Great is the truth and it will prevail," but "Great is fiction because they like to have it." In 1912 prices fell to 9s., and in 1913 below 9s., and they ranged between 9s. and 10s. until the war came. We think we have proved our case without a flaw, either in the facts or in the arguments.

Since the bounties were abolished ten years had elapsed before the war came. Many people have from time to time taken the trouble to ascertain the average price of sugar during a portion of the bounty period and during a period of the same length since bounties were abolished. The results have always shown that there was practically no difference between the average prices of the two periods. The extremely low prices during a portion of the three or four years when the German and Austrian cartels were in operation were of course exceptional. If the Brussels Convention had not come to the rescue the threat of the German producers, that they would keep up the over-production and the ruinous prices and thus crush all competition, would have been successfully carried out. Presently they will try again.

G. M.

Formulae for computing Mill Extraction.

By NOËL DEERR.

In the *Engineer* of February 16th, 1917, Mr. P. H. PHARR has developed certain methods for calculating the extraction of juice from the cane with different milling trains. These formulae are more convenient than the method of successive approximations that I employed in "Cane Sugar," as is quite properly remarked by Mr. PHARR. At the time when I made those calculations the 9-roller train was standard practice, and the 12-roller train was still being developed. As now 15, 18, and even 21-roller trains are common, a complete algebraical solution of the different systems of maceration may be useful.

Consider the cane as composed of fibre, f, and juice, $1 - f$, the juice being of uniform composition; let the cane be crushed till it contains m fibre. Then the bagasse weighs per unit of cane $\frac{f}{m}$, the juice is $\frac{m - f}{m}$, the juice obtained per unit of juice present in the cane is $\frac{m - f}{m(1 - f)}$, and the juice remaining in the bagasse is $\frac{f(1 - m)}{m}$.

Now to $\frac{f}{m}$ bagasse let w water be added with complete admixture; there now results $\frac{f(1 - m)}{m} + w = \frac{f + wm - fm}{m}$ diluted juice; let this be again crushed till the bagasse contains m fibre when there will be obtained $w \div \frac{f + wm - fm}{m} = \frac{wm}{f + wm - fm}$ parts of juice per unit part of juice present in the bagasse. This process may be indefinitely repeated and the same proportion extracted at each operation.

Now for convenience of writing let $\frac{wm}{f + wm - fm}$ be put equal to r, and let the juice remaining in the dry crushed bagasse be unity; then with the addition of w water r juice is obtained and $1 - r$ remains in the bagasse; again adding w water $r\ (1 - r)$ juice is obtained, and the total quantity obtained with two additions of w is $r + r\ (1 - r)$; with n operations the sum of these terms is $1 - (1 - r)^n$. Hence the equivalent weight of original juice obtained in the dry crushing and n wet crushings is $1 - \frac{f}{m} + \frac{f(1 - m)}{m} \left\{1 - (1 - r)^n\right\}$, and the extraction is the above quantity divided by $1 - f$ and multiplied by 100.

The comparison between single and multiple addition of water is of most interest when w is constant; when w water is used in one operation let $r_1 = \frac{wm}{f + wm - fm}$ juice be obtained; now let $\frac{w}{2}$ water be used in two successive operations; then r_1 becomes $\frac{wm}{2f + wm - 2fm} = r_2$, and the juice obtained in the two operations is $1 - (1 - r_2)^2$, and generally in n operations with $\frac{w}{n}$ water used in each the juice obtained is $1 - (1 - r_n)^n$. This expression increases as n increases. As a special case, let $f = 0{\cdot}1$, $w = 0{\cdot}3$, and $m = 0{\cdot}5$ (i.e., fibre 10 per cent., water 30 per cent., cane and fibre 50 per cent. in bagasse). Then,

$$\frac{wm}{f + wm - fm} = 0{\cdot}75 = r_1,$$

$$\frac{\frac{wm}{2}}{f + \frac{wm}{2} - fm} = 0{\cdot}60 = r_2, \qquad \frac{\frac{wm}{3}}{f + \frac{wm}{3} - fm} = 0{\cdot}5 = r_3, \text{ and}$$

$$1 - (1 - r_1) = 0{\cdot}75, \qquad 1 - (1 - r_2)^2 = 0{\cdot}84, \qquad 1 - (1 - r_3)^3 = 0{\cdot}875.$$

That is to say, with all the water used in one operation 75 per cent. of the juice is obtained of that present in the dry crushed bagasse; with the addition of a second mill and with the same quantity of water used in two operations, 84 per cent. is recovered, and with a third mill the proportion rises to 87·5 per cent.

The expressions for compound saturation, i.e., a process in which all the water is added at the last mill and the dilute juices systematically returned to the preceding mills, may be found as follows. As before, let the juice in the bagasse be unity, let w water be used, and let $\frac{wm}{f + wm - fm}$ be denoted by r. Then in the first operation r is extracted and $1 - r$ passes away in the wet crushed bagasse; now let r be returned to the dry crushed bagasse which will now contain $1 + r$, from which $r\ (1 + r)$ is extracted and $(1 + r)\ (1 - r)$ passes away in the bagasse; then returning $r\ (1 + r)$ the third operation starts with $1 + r\ (1 + r)$ from which $r + r^2\ (1 + r)$ is extracted, and $1 - r + r\ (1 - r)\ (1 + r)$ passes away in the bagasse; after n operations the quantity remaining in the bagasse is $(1 - r)^2 + r\ (1 - r)^3 + \ldots + r^{n-2}\ (1 - r)^n\ (1 + r)$. The sum of this expression to infinity is $\frac{(1 - r)^2}{1 - [r\ (1 - r)]}$, which gives the quantity of juice passing away in the bagasse. The quantity extracted is:

$$1 - \frac{(1 - r)^2}{1 - [r\ (1 - r)]} = \frac{r}{1 - r + r^2}.$$

This expression gives the extraction on the juice in the dry crushed bagasse as obtained with two wet crushing units, all the water used being added in front of the last mill, the diluted juice here expressed being returned in front of the penultimate mill. With three wet crushing units the proportion of sugar left in the bagasse is $\frac{(1-r)^3}{1-[r(1-r)^2]}$, and the extraction is $\frac{2r-r^2}{1-r+2r^2-r^3}$, and generally with n wet crushing units the juice left in the bagasse is given by the sum of the series:

$$(1-r)^n + r(1-r)^n(1-r)^{n-1} + \dots = \frac{(1-r)^n}{1-[r(1-r)^{n-1}]},$$

and the extraction is $1 - \frac{(1-r)^n}{1-[r(1-r)^{n-1}]}$.

As a special case, as before let $w = 0{\cdot}30$, $f = 0{\cdot}10$, and $m = 0{\cdot}50$; then $\frac{wm}{f+wm-fm} = r = 0{\cdot}75$, whence $\frac{r}{1-r+r_2} = 0{\cdot}923$, and $\frac{2r-r^2}{1-r+2r^2-r^3} = 0{\cdot}984$.

That is to say, with compound saturation and two wet crushing units 92·3 per cent. of the sugar in the bagasse is recovered, and with three wet crushing units the proportion rises to 98·4 per cent. These figures are very much higher than those found for single, double, and triple saturation.

The above equations refer to an ideal cane with juice of uniform quality, and to an ideal admixture of added water; actually the first expressed juice is richer than that remaining in the bagasse after the dry crushing, and the admixture of the water is far from perfect. These facts modify, but do not invalidate the argument; if it is desired to apply them to actual working conditions in computing extractions, all that is necessary is to write $\frac{a(m-f)}{m(1-f)}$ for $\frac{m-f}{m(1-f)}$ where a is greater than unity, and for r to put br where b is less than unity, though the actual determination of the values of a and b is difficult.

Finally, to give a conspectus of the results to be obtained from these formulae and to give a comparative view of the benefits of the different methods, I add a table calculated by their use and constructed as follows:—Cane contains 10 to 15 per cent. of fibre and is dry crushed to 50 per cent. of fibre, the same percentage being assumed in the wet crushings; the water added is 10 per cent., 20 per cent., and 30 per cent.; by single saturation is meant one addition of water without return of dilute juice; by double saturation, two additions of water also without return of juice; by single compound saturation is meant the use of all the water at the last mill and return of the dilute juice to the penultimate mill; by double compound is meant the use of all the water at the last mill, return of this juice to the penultimate mill, and the return of the penultimate mill juice to the antepenultimate mill. These methods would include a crusher and 9, 12, and 15-roller mills, treating the crusher and first six rollers as the dry crushing unit.

In constructing this table the juice is assumed to be of uniform composition and the admixture of water is considered to be perfect.

---

[*] It is easy to see that this expression is also the general equation for computing the extraction in a diffusion battery.

TABLE GIVING COMPUTED EXTRACTION IN DIFFERENT SYSTEMS OF MILLING FOR *f* 0·10 to 0·15, *w* 0·10 TO 0·30, AND *m* 0·50.

f =	10	11	·12	·13	·14	·15
Dry crushing, *w* = 0	88·9	87·7	86·4	85·0	83·8	82·3
Single saturation, *w* = 0·10	94·4	93·6	92·5	91·4	90·5	89·3
,, ,, *w* = 0·20	96·3	95·7	94·9	94·2	93·4	92·5
,, ,, *w* = 0·30	97·2	96·6	96·1	95·5	94·8	94·2
Double ,, *w* = 0·20	97·2	96·6	96·0	95·3	94·5	93·6
,, ,, *w* = 0·30	98·2	97·7	97·2	96·7	96·2	95·7
Triple ,, *w* = 0·30	98·6	98·2	97·8	97·3	96·8	96·2
Single compound saturation, *w* = 10	96·3	95·4	94·6	93·7	92·7	91·6
,, ,, ,, *w* = 0·20	98·4	97·9	97·5	97·0	96·5	96·1
,, ,, ,, *w* = 0·30	99·1	98·9	98·6	98·3	98·0	97·7
Double ,, ,, *w* = 0·10	98·4	98·0	97·5	97·0	96·5	95·9
,, ,, ,, *w* = 0·20	99·5	99·3	99·2	99·0	98·7	98·4
,, ,, ,, *w* = 0·30	99·8	99·7	99·6	99·5	99·4	99·3

The Extraction of Sugar from Final Molasses.

By H. C. PRINSEN GEERLIGS, Ph.D.

Finding in the *International Sugar Journal* for July (page 297) two rejoinders to my recent article on the extraction of sugar from final molasses[1] I take the opportunity to answer them here simultaneously.

It is the case that on page 88 of the 1903 edition of my work "On Cane Sugar and the Process of its Manufacture in Java" I wrote the following sentences: "It is true that after higher concentration more sugar crystallizes, but this takes place in such a form that it cannot be separated;" but this sentence should be read in connexion with some foregoing lines which run as follows: "It may happen that a very sticky molasses, having a high saccharine content, is already practically exhausted, because its nature does not admit of any further evaporation, as in such a case the boiled mass would become too viscous to allow of crystallization.

"In these cases the molasses contain so much gummy matter that one is obliged to leave much water in them, lest they should coagulate into a sticky mass of jelly after evaporation and cooling. If evaporation is actually carried on to this point, the crystallization is hindered, and the minute crystals can no longer be separated from the adhering sticky mother liquor, thus practically preventing them from being recovered.

"If in order to avoid this the molasses are left less concentrated, too much sucrose remains dissolved and does not crystallize, for which reason the loss of sucrose in molasses is disproportionately high. Though the solubility of the sugar is in any case exclusively influenced by the proportion between glucose and ash, the quantity of water which we are compelled to leave in the molasses is regulated by the nature of the total amount of the non-saccharine bodies, because in practical working the massecuites have always to be boiled in such a way that a certain circulation remains possible. It is true that after higher concentration more sugar crystallizes, but this takes place in such a way that it cannot be separated."

This means therefore that on concentrating a molasses, sucrose crystallizes out to the limit fixed by the ratio between glucose and ash, but in practical working, as accomplished in those days, viz., boiling string-proof, the last particles of sucrose crystallize out in a form so fine that they cannot be recovered, therefore we have to leave more water in the boiling than we should like to and lose more sugar than corresponds with the composition of the sugar-salt combination.

---

[1] *I.S.J.* 1917, 159.

The above quotation was written as far back as 1903, when the last boilings were boiled string-proof, but just as CYRANO DE BERGERAC remarked in Rostand's play, "*J'ai fait mieux depuis.*" I have since showed that on boiling last molasses on grain with a *pied de cuite* of massecuite from syrup or of fine grain, the massecuite could be evaporated till all of the free water was driven out and only the sugar-salt combination remained in the liquid.

Mr. WILLIAMS does so by boiling string-proof, cooling, curing and dissolving again, but I have shown that the same thing could be done in one operation simply by boiling on grain to a high concentration in the vacuum pan and cooling in movement, while the massecuite can be cured in no more than three days and gives up all its content of free sucrose, leaving the portion immobilized by the salts in the molasses.

I do not believe that when evaporating the water out of the hydrated salt-sugar combination this will be broken up into its components, any more than that a crystallized salt, *e.g.*, copper sulphate, is broken up into copper oxide and sulphuric acid merely by driving off its crystallization water. My firm belief is that these combinations keep equally in a dehydrated state and do not split into crystallizable sucrose and salt.

It has been the custom in Java for the last ten years to evaporate the water from the exhausted molasses and to turn it into a solidified mass. I have seen hundreds of such boilings and in no instance did they show any trace of crystallization; they were always amorphous and at least some of them might have been crystalline if that combination were broken up by desiccation at so low a temperature as prevails in a good vacuum pan.

In the process described I can easily produce exhausted molasses of 27° apparent purity (degrees Brix and polarization). If Mr. WILLIAMS can produce molasses of 20° purity, that is desaccharified by evaporation and not by leaving them standing a long time in cisterns where they may become partly inverted, his scheme beats mine.

Finally I can assure Mr. WILLIAMS that in reality the last massecuites may be boiled down to 98° Brix (not per cent. solids). If on curing at 45° C. they are found too sticky they may be diluted in the coolers with water or with dilute molasses without fear of re-dissolving sugar. This means, of course, that the mixing is done carefully and not too extravagantly. The dehydrated salt-sugar combination takes up water till the proper amount of water of constitution is restored and it is not thereafter that the water will be able to dissolve any of the crystallized sucrose. I would request Mr. WILLIAMS to go to work as I have described in my book and see if the method laid out there is not practicable. It is not our aim to advocate special processes, but to promote the status of the industry. In this respect I am most firmly convinced that we cannot do better than avoid all boiling to string-proof and derive the best profits from boiling to grain. I have been able to bring down the purity of the Java molasses considerably and to increase the output of sugar by abolishing boiling smooth and by doing away with all hot-room processes.

When boiling on grain with a *pied de cuite* of massecuite from syrup or of fine grain, this may be accomplished with ease, and if the last massecuite is made to an apparent purity of 60° and boiled to, say, 98° Brix, it may be separated into raw sugar and exhausted molasses of, at a minimum, 27° apparent purity. If the massecuite is too stiff, it is diluted with water or dilute molasses.

I do not want to indulge in theoretical observations here, but merely ask that the method be given a fair trial to see if it is satisfactory or not.

The Use of Vegetable Decolorizing Carbon as compared with Animal Charcoal (Bone-black) in Sugar Refining.

By M. WEINRICH.

My attention has been drawn to an advertisement of the Norit White Sugar Co., which contains such astonishing claims as to challenge criticism.

Having made years ago, first alone in the United States, and later on in London in collaboration with the late BENJAMIN E. R. NEWLANDS, an authority on sugar refining, a great many experiments with various kinds of vegetable carbons in comparison with animal charcoal (bone-black), readers of the *International Sugar Journal* may be interested to learn something of these investigations.

One kind of carbon which we tried decolorized fully as well as the best blood char. We revivified the used materials in well-known ways, either by boiling them in a solution of soda of 5° Bé. (the Glauzig process), or in one of ammonia (Dr. Eisfeld's process).

As the result of these experiments we found that: (1) the specific gravity of the best kind of carbon was only about 10 per cent. that of char, or in other words, it was extremely bulky; (2) even the best kind removed only colour, and neither organic nor mineral impurities, which char does; (3) after each revivification, which is both troublesome and expensive, the material, being very soft and amorphous, shrunk more or less, and its absorptive power was reduced in proportion; (4) a certain volume of the best grade used did not remove more colour than the same volume of finely divided char, passing through a 30-mesh sieve· Char removed considerable impurities, but the vegetable carbons none.

In consideration of all these drawbacks, we dropped the subject, because in our opinion vegetable carbons, if used on a large scale in sugar refining could not compete with char, kept at high efficiency. This opinion was shared by Dr. PRINSEN GEERLIGS and other prominent experts.

I have read carefully Mr. Wijnberg's specifications, and have noted the claims of his U. S. Patents No. 1,070,654 and No. 1,074,337, on the strength of which his Company was formed.

Claim 2 of Patent 1,070,654 reads:—"The process of refining raw sugar juices, which consists in acidifying such juices with about 1 per cent. of normal acid, mixing the said juices with decolorizing carbon and filtering to separate the decolorizing carbon." Claim 2 of Patent No. 1,074,337 says:—"A process for regenerating decolorizing carbon containing more than 50 per cent. of pure carbon, and having a decolorizing power higher than bone-black, and containing absorbed impurities, comprising treating said decolorizing carbon with alkaline solutions of such strength as to dissolve or destroy said absorbed impurities."

I believe Mr. WIJNBERG will have some difficulty in finding a refiner willing to acidify his liquors to the prescribed degree, to add some Norit (which is neutral), and then to boil for 15 minutes according to the specification. The result would be disastrous: an enormous inversion.

Mr. WIJNBERG claims in his Patent 1,070,654 that he has "discovered that the regeneration of the decolorizing carbon can be obtained by treating with caustic alkalis or carbonates, or both, after which the decolorizing carbon is washed, etc."

Let me tell Mr. WIJNBERG that he is more than 40 years late with this "discovery," because this same process was in use for bone-black many years ago in several beet sugar factories and refineries in Germany. When travelling in Germany with the late THEODORE A. HAVEMEYER, the first president of the Sugar Trust, I saw the process in operation in the Glauzig factory near Halle. Mr. HAVEMEYER, who knew a thing or two about sugar refining, severely criticised this mode of revivifying as far too expensive and troublesome, and later on it was abandoned at Glauzig. It seems quite immaterial whether the carbonaceous filtering material contains 10 or 50 or more per cent. of carbon—the *process* remains the same.

Mr. WIJNBERG is now stating in his advertisements that "no acid need be used in the sugar liquors with Norit, and soda is not absolutely essential for the revivification of the Norit." If this is so, I would ask what remains of Mr. Wijnberg's patent claims?

Another claim in favour of Norit is "the total elimination of the bag filtration plant." We all know that raw sugar liquors from washed or unwashed sugar and also the washings are defecated with lime and phosphoric acid whereby a considerable scum is formed afterwards to be filtered off. Mr. WIJNBERG proposes to add to the defecated but unfiltered liquors some Norit together with some kieselguhr and then to filter through presses. I do not doubt that this is feasible, but I ask the inventor how he will separate in the resulting filter cakes the scum from the Norit and revivify the latter? Moreover, it is a well founded rule with sugar refiners never to bring muddy liquors in contact with decolorizing agents.

But Mr. Wijnberg's most stupendous claim reads as follows:—"3 per cent. of Norit will do the decolorizing work of 100 per cent. of animal char! This means that thirty times less bulk has to be handled!"

In reply to this I wish to say that it will be rather difficult to prove that 1 cub. ft. of Norit will decolorize any more than 1 cub. ft. of finely divided good bone-black, not to speak of the purifying efficiency of the latter. And thirty times as much is claimed!

Referring to the vegetable carbon called "Carbrox," now so much advertised, made from cereal fibrous material, reference should be made to U.S. Patent No. 455,675, granted to me July 7th, 1891. In this old patent I describe and claim: "As a material for the filtration of sugar solutions, or other solutions or liquids, the fibre, crude or charred, of the described grasses whose stalks or stems have an internal marrow or pith."

Since cereals belong likewise to the family of the grasses (*Graminae*) it seems that this patent anticipates Dr. Shilstone's invention. Although I found later that the use of these *charred* grasses (cane bagasse, corn stalks, etc.) is too expensive, I can recommend the use of finely comminuted *crude* bagasse as a filtering agent, costing practically nothing. By passing the bulk of the bagasse before it goes to the furnaces over a perforated sieve agitated by a crank shaft, enough fine bagasse can be obtained for addition to the defecated juice, all of it being then filtered through presses. Full cakes can be obtained, which are easily washed, while the juice will be perfectly clear. What a clear juice implies regarding the quality of the finished product, every manufacturer knows.

To sum up: It is the opinion of the writer that vegetable carbons if used on a large scale in the refining of sugar will offer only disadvantages compared with bone-black.

CAPTAIN BATHURST, M.P, who was till recently representative of the Food Controller's Department in the House of Commons, has been appointed Chairman of the Royal Commission on the Sugar Supply, in the room of VISCOUNT DEVONPORT, resigned.

Prospects in Cuba.

Sugar in its August issue gives us some remarkably interesting and instructive details about Cuba, the greatest sugar producing country in the world. The increased cost of Cuban raw sugar, according to the detailed statement of a bank manager in Havana, is very striking. According to the author's figures the present cost of producing raw sugar laid down at the port of shipment in Cuba is 3·04 cents per lb., against the previous cost of slightly under 2 cents per lb. Adding lighterage, warehousing, freight, insurances, and import duty in United States, the cost per lb. laid down at New York is now, therefore, 4·651 cents.

The report of the United States Consul General in Havana is most interesting. The total production of the 1917 crop, estimated at 3,500,000 tons, he put at 2,800,000 long tons under the most favourable conditions.[1] But the actual loss would be far greater. The estimate of 3,500,000 tons would have been exceeded but for the disturbances. The possible production was 3,571,400 tons. The average yield of sugar per acre is about 2½ tons. In one district of the Oriente Province the damages done by the disturbances cannot be immediately recovered because most of the cane fields destroyed by fire have not yet been cleaned. In another district, where the largest sugar mills in the world are situated, the burnt fields have been cleaned and it is estimated that under favourable conditions the next crop will be considerably in excess of the estimated 1917 crop. In two other provinces, Camaguey and Santa Clara, visited by the disturbances, the destruction was far greater than in the province of Oriente. Railway bridges, railway stations, and one half of the cane crop were destroyed.

In spite of all this, Cuba will be able to produce more than 3,500,000 tons in 1918. A number of large new mills and thousands of acres of new land will be added.

The difficulties will be transportation and labour. Lack of transportation facilities causes the locking-up of thousands of tons of sugar in local warehouses on which mill owners are unable to get any advances from the banks. As to labour, the revolution caused thousands of Spaniards, Haitians, and others to leave the country, and it is feared they will not return; 50,000 extra hands will be necessary.

The writer concludes with a striking eulogium on the fertility of the soil. It is capable of producing a much greater yield, most of it being virgin soil. Three crops of corn can be raised each year. Cane reproduces itself each year for 20 to 25 years, and the only fertilization required is the leaves from the cane at harvest time. The country also contains thousands of acres of grazing lands, and vegetables of all kinds grow continuously.

Thus we see that Cuba (and Java) remain, at present, the most favoured of all cane sugar producing countries. But there are other virgin sugar soils in the tropics not yet exploited. The British Empire must enter the field and "do its bit" in supplying the United Kingdom with enough sugar for its home consumption.

The Royal Commission on the Sugar Supply hold that the following should be the maximum prices of sugar within the United Kingdom:—Pieces, 5¼d. per lb.; granulated, 5¾d. per lb.; cubes, 6½d. per lb.

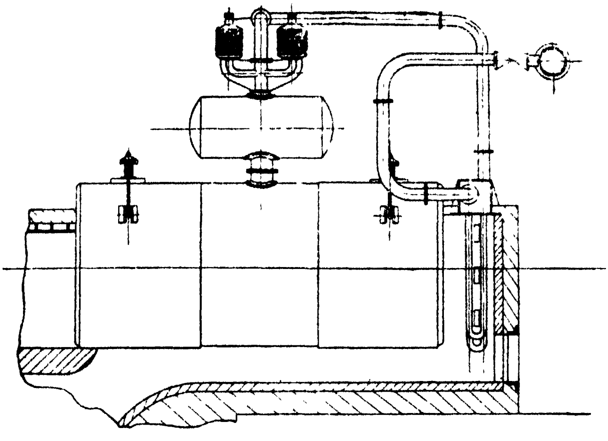
---

[1] Since he wrote his report, his figure has been exceeded, for, as will be seen on page 436, Messrs. Guma & Mejer give the total production down to July 31st as 2,847,319 tons, while Willet & Gray still hold to their recent estimate of 3,000,000 long tons for the Cuban crop.

Superheated Steam in the Sugar Factory.

By FRANK COXON.

In last month's issue a few notes were given on the use of superheated steam as applied to the smaller type of factory; the accompanying drawing now shown indicates clearly the proposed arrangement of superheater setting.



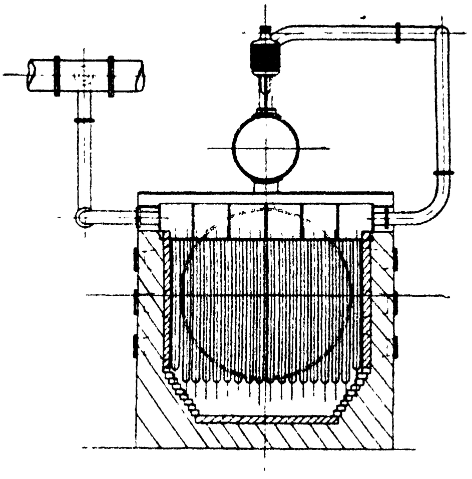
Side Elevation.

It will be seen how simply the attachment can be made with a minimum of pipe and brickwork alteration when applied to the multitubular boiler.

Inspection doors as shown should be built in for the periodical cleaning with a steam jet.

Regarding the position of the stop valve it will be obvious that this must not be placed between the superheater and boiler, but should be taken from its usual place on the boiler mounting and fitted at the junction of the boiler steam pipe to the steam main.

When water collects in the superheater from cooling down, the steam upon re-generation will then go to the boiler, the superheater being isolated as well as the boiler from the main steam pipe or other boilers.



End Elevation.

It was stated during the summer that there had been no less than 750,000 applications for sugar for preserving on behalf of alleged growers of fruit. But since then there have been hundreds of prosecutions all over the country of persons charged with applying for such sugar without the qualification that they grew the fruit they were bent on preserving. A goodly proportion of these delinquents intended to buy the fruit and preserve it; but there were also cases of fraud pure and simple, where the applicant had no intention of using any appreciable proportion of the sugar to preserve fruit. Heavy fines have been in many instances inflicted.

The United States Beet Sugar Industry.

A Federal Trade Commission Report.

An investigation into the conditions in the beet sugar industry in the United States, especially those relating to the costs and profits of growing sugar beets, the cost of manufacturing and marketing beet sugar, the profits in the manufacture and sale of beet sugar, and the relations between sugar beet growers and beet sugar manufacturers, was undertaken some time ago by the United States Federal Trade Commission at the instigation of the Secretary of Commerce, owing to complaints on the part of farmers that they were not receiving a fair price for their roots.

The investigation covered in detail the operations of all the beet sugar factories in the States except two small ones, during the five-year period ending with the business year of 1913-14. The results of the inquiry have now been incorporated in a report which was recently submitted to Congress. This report is admittedly a belated one, but its issue has been delayed, much to the regret of the Commission who would have liked to have brought the information down to a later date, but such a course was not possible because it went beyond the limits laid down for the Commission's investigation. As a result, the findings now published are rather more of historical than of current interest. What follows below is taken by us from the Letter of Submittal addressed to Congress, and may be considered an accurate if brief summary of the facts which the Commission ascertained.[1]

The present extent of the industry.—In 1914, 700,000 tons of beet sugar was produced in the United States in 78 factories. The four principal centres of production were Michigan and Northern Ohio, Colorado, northern Utah, and southern Idaho and California, but 12 other States contributed to the total production. Michigan and Colorado each had 16 factories in 1914, California had 13, Utah seven, Idaho and Ohio five each, and Wisconsin four. There were ten States that had only one factory each. California and Colorado produced more than 50 per cent. of the total production of the country during the five years covered by the report. The annual consumption of sugar in the United States is approximately 4,300,000 tons, and about 16 per cent. of this was produced in domestic beet sugar factories in 1913-14.

Growth of the industry.—There were only three beet sugar factories in operation in the United States in 1870, and this number had increased to only nine by 1897, but in 1914, as already stated, there were 78. The production has increased from less than 45,000 tons in 1897 to more than 700,000 tons in 1914.

The rapid development of the industry after 1897 has been largely due to direct encouragement by the Federal and State Governments, particularly the former. While Customs tariffs have afforded a large measure of protection to the industry since 1883, it was not until after the Tariff Act of 1897[2] that the rapid development of the industry began. In 1897 Michigan enacted a State bounty law which greatly stimulated the building of factories in that State. Soon afterwards other States enacted similar laws, but they were all, including those of Michigan, soon repealed or declared unconstitutional.

---

[1] Federal Trade Commission: Report on the Beet Sugar Industry in the United States. Washington Government Printing Office, 1917. Price, 20 cents.

[2] By the Act of 1897 the duty was fixed at 0·95 cent. per lb. on sugar not above No. 16 D.S. and not above 75° polariscope test The additions for the higher tests made the rate on 96° sugar 1·685 cent. per lb. These rates remained in force till March, 1914, except as to sugar from the Philippines and Cuba.

Cost of producing beet sugar.—The average cost for 64 factories producing 96 per cent. of all the beet sugar in the United States during the five years ending with the season 1913-14 was $3.74 (15s. 5d.) per 100 lbs., including depreciation, which for these factories averaged 25 cents. The average cost of 36 factories producing 74 per cent. of the sugar was $3.46 (14s.3d.); the average for 26 factories producing 57 per cent. of the sugar was $3.36 (13s. 10d.). On the other hand, 21 factories producing 15 per cent. of the sugar had an average cost of $4.84 (19s. 11d.) There was a wide range of cost in different factories. The lowest average cost for any factory for the five-year period, including depreciation, was $2.94 (12s. 1d.), and the highest was $6.45 (26s. 6d.) per 100 lbs. Speaking broadly, this wide variation was due mainly to differences in the cost of beets per 100 lbs. of sugar, but there were also wide differences in the cost of manufacture. The average cost of beets per 100 lbs. of sugar for these 64 factories during the five-year period ranged from $1.64 to $4.48 (6s.9d. to 18s.6d.), while the additional cost of production, including overhead expenses but not including depreciation, ranged from 44 cents to $2.44 (2s. 10d. to 10s.). In general, high cost of beets is accompanied by high cost of sugar.

There was also a notably wide variation in average costs in different States. The lowest average cost for the five-year period, including depreciation, was $3.27 (13s. 6d.) per 100 lbs. in California, and omitting the States that had only one factory each, the highest average cost was $4.88 (20s.) in Wisconsin. The average cost of beets in California for the five-year period was only $2.05 (8s. 5d.) per 100 lbs. of sugar, while in Wisconsin it was $3.50 (14s. 5d.).

Earnings in the beet sugar business.—With respect to earnings the report covers 37 companies, operating 77 factories, that produced nearly 99 per cent. of all the beet sugar manufactured in the United States during the five years ending with the season 1913-14. During this period these companies earned in the sugar manufacturing business an average of 11 per cent. on the capital employed therein. The average earnings of all the companies by years ranged from 16 per cent. in 1909-10 to 3 per cent. in 1913-14. In no other year, except 1913-14, were the average earnings as low as 8½ per cent. The extremely low earnings in the year 1913-14 were due to the unusually low prices of sugar.

Some companies operated at a loss during most of the period, while others made very large profits. Thus, the operations of 29 companies producing 95 per cent. of all the beet sugar manufactured in the United States during the five-year period showed average results varying from a loss of nearly 18 per cent. to gains of nearly 45 per cent. Thirteen companies producing 75 per cent. of all the beet sugar in the United States had average earnings of more than 9 per cent. on the capital employed in the business, and seven companies producing 53 per cent. of the sugar earned on the average over 16 per cent. On the other hand, 16 companies that earned on an average less than 5 per cent. produced 13½ per cent. of the sugar, and nine companies operating at an average loss produced only 9½ per cent. of the sugar.

Upon the whole, capital employed in the beet sugar business earned very fair returns during the period.

Beet growing.—The cost of growing and selling sugar beets and the gross return from their sale were secured from a number of representative growers in every locality where beet sugar is manufactured. There was found a wide range of results varying from actual losses to large profits. The expense of growing and marketing beets is very high. It was found to range from a little less than $35 (£7 4s.) to more than $50 (£10) per acre. The gross returns, however, were correspondingly high. The average annual returns in the various beet sugar districts for a period of three years ending with 1913 ranged from about $60 (£16) to more than $75 (£20) per acre, and the average net profit per acre ranged from less than $20 (£5 8s.) to about $40 (£10 16s.). The highest net profits per acre were found in California, Colorado, and Utah. The lowest net profits in any district of considerable size were in Michigan, where the figure was only $17 (£4 8s.) per acre.

Comparing the net profits of beet growing with those from other branches of agriculture, it appears probable that no other important standard crop would year after year yield better net returns per acre than beets. Many farmers, however, insist with apparent reason that they are entitled to a better return on beets than on most other crops. This is because of the unusual care and diligence required to grow them as compared with general field crops, and because of the usually large outlay of cash for labour.

With respect to the complaint of the farmer that he does not receive a fair price for his beets, it is generally, though not universally, admitted that beets are more profitable than most other crops. The beet grower contends, however, that the prices he receives should depend upon the prices of sugar; in other words, that he should receive a price as high as the profits of the beet sugar manufacturer will enable him to pay. The manufacturer, it should be noted, guarantees a price for beets before the seed is planted, thus assuring the grower a market at a fixed price. It is therefore argued, on the other hand, that as the manufacturer always assumes the risk of a decline in the price of sugar, while the farmer assumes no risk whatever in the price of beets, the latter should be content with the prices he has been receiving unless he is willing to assume the risk in a fluctuating sugar market. It is pointed out that it would be a shortsighted policy on the part of the manufacturer to force down the price of beets to a point unprofitable to the farmer, because in so doing he would force him to abandon that crop for others affording a profit.

The principle of basing the general price of beets upon the price of sugar seems to be an equitable one, but whether it can be made practical in its application can be determined only by experience.

As regards the points at issue between the farmers and the manufacturers, mentioned in the last two paragraphs above, it may be useful to reproduce here the detailed arguments given in the body of the Report on the test of a fair price for beets.

"The beet grower often complains that he does not receive a fair price for his beets. The sugar manufacturer replies that the farmer makes as much or more money on his beets as he does on any other crop. This is probably, in the main, true. The farmer rejoins with the assertion that the manufacturer makes large profits extracting sugar from beets and that he can afford to pay more for them than he does pay. This also is sometimes true. It is thus seen that the manufacturer applies one test as to the fairness of the price and the beet grower applies another. The contention of the grower that the large profits of the manufacturer would often enable him to pay a higher price than he does pay implies the idea of co-operation. If the profits of a manufacturer are a fair criterion for the establishment of the price of beets, then the grower should be willing always to accept a price low enough to enable the manufacturer to realize a profit. In other words, on this basis of establishing the price of beets, when the sugar business is prosperous the beet grower would receive a high price, and when it is not prosperous he would receive a low price. If this system of determining prices had been employed in the past the farmers supplying a number of factories would have received a very much lower price for beets than they have received. On the other hand, the farmers in the vicinity of other factories would have received a very much higher price. Some factories have never made much money and have often lost large sums. If the farmers had shared these losses, the results of their beet-growing operations would have been disastrous.

"With a fixed price for beets the intelligent, industrious farmer is generally assured a fair return for his efforts. As soon as he harvests his beets he knows precisely what he has made. This advantage of certainty is unquestionably worth considering. If the price of beets depended absolutely upon the vicissitudes of the sugar market it is doubtful whether any considerable number of farmers would be willing to engage in this branch of agriculture. Upon the whole, therefore, it would seem that the principle involved in the present system of determining prices of beets is the more advantageous to the beet grower. This system, however, might be more equitable by basing the fixed price more nearly upon the sugar content and purity of beets. The sugar manufacturer knows the relative value of beets of different tests, and he should be willing to pay a price that will place all farmers upon an equal basis. It is manifestly inequitable to fix a flat price for beets based upon a range of sugar content embracing as much as 2 or 3 per cent. If the farmer who grows 12 per cent. beets is entitled to a given amount, say $4.50 per ton, then beets testing 13, 14 or 15 per cent. are worth proportionally more and should be paid for on that basis. On the other hand, if the base price is fixed on a sugar content of, say, 15 per cent., then the farmer's beets which test below this are not worth as much as the basis price and he should not expect to receive that price for them.

"As already pointed out, the terms of some beet contracts made in 1915 provided for a minimum price for beets and an addition to that price in case the price of sugar should be above a certain figure. Such a basis for determining the price of beets deserves careful consideration. The fixing of the price of a raw material a year in advance of the time when the value of the manufactured product can be determined invólves considerable speculative risk.

"If it is practicable to base the price of beets upon the price of sugar, such a system would appear to be entirely reasonable and fair. Under such circumstances the beet grower would be assured of all his beets are worth, and the manufacturer would in no case be compelled to pay more than the price of sugar would warrant. It would seem much more reasonable to determine the price of beets upon this basis than upon the basis of the profits of the manufacturer. It is realized that there would be some difficulty in determining the proper relation between the price of sugar in the beet and the manufactured product. If the price of beets could be determined upon some such basis, it would at least tend to eliminate the controversies that are now so frequent between the beet growers and beet sugar manufacturers with respect to the price of beets. Whether determining prices for beets on such a basis would discourage their cultivation is a question which only experience could answer."

The American Bureau of Crop Estimates puts the present American beet crop in its August report at 7,820,000 short tons of roots, which with the same percentage of sugar content as last year (13·86) should give a total yield of 1,085,852 short tons of sugar. If this forecast is fulfilled, it means that the American domestic beet sugar industry has for the first time topped the million-ton mark.

Sugar Cane Experiments in British Guiana.

Season 1915.[1]

The sugar cane experiments carried out on the experimental fields of the Department of Science and Agriculture, British Guiana, during 1915, were somewhat adversely affected by bad weather conditions, and the total number of seedlings raised was only 3730, or 6000 less than in the previous year. Of these 505 were possible hybrids and 147 were the product of self-fertilization.

Of the crops reaped, those varieties under manurial trial gave results indicating that applications of sulphate of ammonia containing a high proportion of nitrogen gave better results than applications of nitrate of soda containing an equivalent nitrogen content. Dressings of superphosphate of lime indicated an increase in cane tonnage per acre either in combination with or without nitrogenous manures; but the results did not give much support to the contention that applications of lime tend to increase the sugar content of the canes. Of the varieties under trial in this manurial series, the best cane was Green Transparent with 48·7 tons of cane per acre and 5·42 tons sucrose in expressed juice.

A new series of manurial experiments was commenced with the primary object of comparing the manurial value of the nitrogen in animal refuse manure with certain artificial nitrogenous manures, the latter being applied in conjunction with phosphoric acid in the form of superphosphate of lime equivalent to the phosphates contained in the organic manure. The experiment is being conducted in two series, the one using equivalent nitrogen values and the other equal money values of the various manures.

Many of the seedlings raised in 1913, which were reaped in the season under review, yielded a juice of high saccharine content and purity. Of the canes of uncontrolled parentage, which were selected for analytical examination, 57·2 per cent. proved to be of high potential value on account of the characters of their juice, while of similarly selected hybrid canes 58·3 per cent. had like characteristics. But only 60 canes of hybrid parentage were obtained suitable for examination, while 430 canes of uncontrolled parentage were selected; hence the value of raising canes from uncontrolled, though selected, parentage proved higher than that of raising hybrid canes.

Of the uncontrolled parentage seedlings 26 varieties were of exceptionally high quality, while only eight of the hybrid varieties were of like character. Thus 13·3 per cent. of the hybrids were of an exceptional nature, as compared with only 6 per cent. of the uncontrolled lot.

On the sugar estates of this colony the gradual substitution of the Bourbon cane by new varieties raised from seed continues. The total area in sugar cane cultivation is now 75,744 acres. Of those, 37,174 are planted with D 625, 9109 acres with Bourbon, 5294 acres with Bourbon mixed with other varieties, 6088 acres with D 145, 6012 acres with B 208, 1360 acres with Green Transparent, and 98 acres with D 167. Practically 50 per cent. of the fields are planted with D 625.

The returns of average yields in tons of commercial sugar per acre were headed by D 167 with 2·26 tons; Green Transparent came fourth with 2·03 tons, and the other extensively cultivated canes had the following yields to their credit: D 625, 1·80 tons; Bourbon, 1·68 tons; D 145, 1·66 tons; and B 208, 1·52 tons. Results of single large trials with certain varieties gave however larger yields, the best being Diamond 37 with 2·88 tons of sugar per acre to its credit.

---

[1] Abstracted from Jl., Board of Agriculture, Br. Guiana, x, 2.

No new serious insect pests of the sugar cane have made their appearance during the year under review and the formidable list of pests remains the same. Fungoid diseases were generally speaking not prevalent, no new diseases being recorded. *Marasmius sacchari* was less evident than in either of the two previous years, while *Leptosphœria sacchari* and *Cercospora vaginœ* showed no increase.

The export of sugar for the year 1915 from British Guiana was 116,223 tons, an increase of 9086 tons over that of 1914. The total export of rum was 4,698,230 proof gallons or 1,209,551 gallons increase over the preceding year. No molasses was exported, as by far the greater proportion of it was used in the preparation of rum. The export of molascuit came to 2233 tons.

The Use of Tops as "Seed" for Planting Sugar Cane.[1]

By R. ROCHE.

It is being questioned whether in the planting of the sugar cane the use of tops may exercise any influence upon the future crops. This question has given rise to numerous experiments in different countries, these in general having shown that the specific qualities of the variety are preserved whatever part of the stalk is planted, whether top, middle, or end.

The writer has carried out some experiments on the planting of cane tops in different soils with control tests, and the conclusions were always that the tops offer the following advantages:—An economy of 30 per cent. of the weight of cuttings; a saving of 40–50 per cent. of the quantity of extractable sugar buried in the soil, on account of the low purity of the tops; the increase of the number of "eyes" planted for the same length of cutting; and the normal preservation of the proper qualities of the variety. On the other hand, there exist the following disadvantages:—The difficulty in countries in which cane rapidly deteriorates on account of the heat in proceeding from harvesting immediately to separating and planting the tops, this being a great drawback in practice, sufficient almost altogether to annul the favourable points already mentioned; and lastly the tendency possessed by the top, thinner than the body of the cane, to rot more readily in soils that are too humid, though in normal soils the power of germination of the top may be better than that of the other cuttings, which are purer and sometimes less rich in salts and in albumenoids, that is to say, in materials utilized by the young shoot.

Certain previously published experiments on this subject have given contradictory results, but this is because control tests were not made, or were insufficient, or because the experiments were not carried out on a large enough number of small plots, the average of which alone has any real signification. Cultural experiments are difficult, and their interpretation is delicate. There are very numerous factors influencing the quantity of extractable sugar produced per unit of area, and almost all of these are subject to large variation from one season to another, or from one plot to another. They are difficult to estimate, and some are little known, or pass unrecognized. It would be desirable for investigators when drawing conclusions from their experiments to endeavour to determine the exact rôle of each of these factors in the final result, and to express it in general rules. And in particular they should ascertain the effect due to the variety or the heredity of the plant, and what relates to cultural conditions properly called.

---

[1] Translated from the *Bulletin de l'Association des Chimistes de Sucrerie.*

When dealing with cultivation the conditions of which are absolutely normal, that is, conforming to the normal exigencies of the plant, there reigns a certain harmony between the influence of the divers factors, and it is then that the qualities of the proper richness of a variety may fully be felt. But experience shows that almost every cultivation represents a particular case owing to the multiplicity of the conditions of every nature. A factor ordinarily secondary may then assume a preponderant influence, and completely modify the results anticipated. It would seem that this applies as well to the cultivation of the sugar cane as to that of the sugar beet. A case has been cited of beet seed originating from a rich variety, which gave very unequal and rather poor beetroots, leading one to believe in its rapid degeneration. It would seem well to enquire with such a result what belongs to heredity, what to the seed, and what to the circumstances accompanying the growth of the plant. The question would then revert to another, which is altogether general, and thus much more interesting.

What are the factors, *all the factors*, influencing the production of the extractable sugar? It is seen that in certain cases rich beetroots may reproduce poor ones under the influence of certain circumstances of vegetation. It may be affirmed that in the case of the sugar cane if a large number of stalks be individually analysed at the end of eight or nine months' growth after being taken one after the other in the same row, that is, sister stalks from the same cutting, one will frequently meet canes of the same age having very different sugar contents, namely 8 to 16, and more generally from 10 to 13 per cent. This shows that certain circumstances during growth may modify profoundly the result, giving at the same time rich and poor stalks, although cultivated in the same way and apparently under the same conditions. Consequently, in the investigation of rich varieties presenting an ensemble of qualities, it is necessary to determine, particularly for the sugar cane, which factors influence the sugar content and how they act. At the present time there exist but inadequate notions on this important subject.

When circumstances permit, it would be desirable for the Association to undertake an enquiry into the experiments that have been made on the subject. The questions to be solved have great consequences, for it is a mistake to direct almost every effort as has been done for many years solely towards the selection of varieties.

The composition of the soil plays a primordial rôle in influencing the richness of the cane, and one does not always take sufficient account of this factor. What takes place in Egypt is very instructive. There the soil is rich in potash, moderately so in phosphoric acid, but poor in nitrogen. There is a little humus. Chemical analysis does not render account at all of the fertility of this soil, which anyway is a fairly general rule. It is very deep, several metres, and the mass of elements utilizable by the plant is considerable owing to the exceptional thickness of the bed exploited by the root system. The Nile water carries but little in solution; but at certain periods it carries along in suspension an ooze which, having appreciably the same composition as the soil. has wrongly been regarded in antiquity, and even in our own time, as a fertilizing material having the value and rôle of a manure. This slime in depositing each year increases the thickness of the soil by an infinitesimal amount, but the manure demanded for cultivation is nitrogen in a rapidly assimilable form applied at suitable intervals and in measured quantities, while guarding against hindering the growth of the cane. Phosphoric acid has little effect; nor has potash any, unless it be the harmful one of lowering the purity of the juice.

Report on Experiments with "Bacterized Peat."[1]

By F. J. CHITTENDEN.

These experiments were begun in 1914 at the request of the Council of the Royal Horticultural Society. Four consignments of peat were used and there was a marked difference in appearance between the different lots.

Object of the experiments.—The experiments were designed to determine whether the alleged acceleration of growth was due to: 1, the water-holding capacity of the peat; or 2, the salts and especially the nitrogen it contained; or 3, the action of hypothetical accessory food bodies which may be called activators.

Experiments in 1914.—The first experiments were carried out with loam in pots under glass. Among others the plants chosen were *Eupatorium adenophorum* and tomato.

Eupatorium adenophorum is particularly suitable for these experiments as it is remarkably uniform in growth and grows quickly at the dull season of the year in an ordinary greenhouse. The luxuriance of growth in the treated peat compost was very marked, the area of the last eight leaves of the plants in the treated peat compost being more than 50 per cent. greater than that of the plants in the untreated pots.

Twenty seedling tomatoes were grown in large pots with ordinary loam. Another series of twenty were grown in soil containing ⅛ of bacterized peat and a third series to which ordinary peat was added. The plants in the soil containing the bacterized peat were much more luxuriant and had darker foliage. This luxuriant growth however was not accompanied by a delay in the flowering period as would be expected. In fact flowers first appeared on these plants and were borne little higher up the stem than were those on the plants in ordinary soil. Little difference was noticeable between the plants in the ordinary soil series and those in the soil and raw peat series.

In these experiments no obvious effect on the root development was observed as recorded by other experimenters, but in all the plants there was a copious branching of the plants growing in the bacterized peat. Comparison of the growth of plants in soil and bacterized peat with that in soil and untreated peat shows that the water-retaining power of the peat is not sufficient to account for the differences in growth.

Increasing the amounts of the bacterized peat up to one half the content of the pots caused very slight increase in growth and no detrimental effect, thus supporting the theory of the existence of "activators" in the treated peat.

Experiments with peat extract.—Tomatoes were grown in sand and watered with the following extracts:—1, water extract of bacterized peat; 2, water extract of boiled peat; 2, water extract of untreated peat; 4, ammoniacal water extract of untreated peat; 5, water alone.

In each case 12 plants were used. The extract was given once a week and water as required. The plants receiving the ammoniacal extract all died within two days. None of the plants grew well but those receiving the bacterized peat extract grew leaves twice the size of the others. There was practically no difference between the plants watered with either of the other peat extracts and those watered with tap water.

These results show that the value of treated peat lies in the water soluble constituents after "bacterization" and that mere heating does not bring about these changes in the peat.

---

[1] Contribution from the Wisley Laboratory (abridged). *Journal of the Royal Horticultural Society*, vol. XLI., Part 2, 305-326. For previous literature relating to the subject see *I.S.J.*, 1914, 238, 536; 1915, 96, 117, 192, 516, 577; 1916, 198, 222, 233, 357, 472; 1917, 284.

Experiments in the open garden.—The soil of these plots is very sandy, but retains sufficient moisture to keep plants growing. Radishes, turnips and French beans were grown. Three plots were arranged for the crops as follows:—Plot A, bacterized peat at the rate of 2 tons per acre hoed in; plot B, no peat or other manure; plot C, untreated peat at same rate as A.

No difference was seen in the growth of the plants on the respective plots, nor was there any difference in the rate of germination. The average weights of the plants from the plots A and B were the same.

On another series of plots "Early White Stone" turnips were sown on May 25th. Plot A, received no dressing; plot B, received bacterized peat at the rate of 1 ton per acre; plot C, as plot B, with an addition of 150 grms. of manganese sulphate. These plots were arranged in triplicate. The results were summarized as follows:—

	Treatment.		
Series	Nothing lbs.	Bacterized peat lbs	Bacterized peat + Manganese lbs.
1	123·5	136	134
2	128	135	118·25
3	75·5	77·25	90

There appeared to be some hastening of growth in the seedling stage by the use of the bacterized peat. In all cases there was a slight increase in the weight of crop due to the bacterized peat. This increase, however, was more in the tops than in the roots where the bacterized peat alone was used. The effect of the manganese salt appeared to be to redress the balance between root and top which was upset by the bacterized peat.

Grass.—A grass plot 10 ft. × 60 ft. was dressed with bacterized peat at the rate of 3 tons per acre, but no visible effect was observed from the dressing.

Turnips.—These results were much inferior to those obtained in the pot experiments. In order to remove the possibility of the soil moisture being the limiting factor, another series of experiments was arranged in open ground artificially watered. The soil chosen was poor and had not been recently manured. Ten plots were used and turnips were grown under various treatments as follows:—

			Average weight per plant in lbs		
	Plot.	Treatment	Tops.	Roots	Total
	1.	Bacterized peat	0·33	0·64	0·97
	2.	,, ,, and farmyard manure	0·34	0·67	1·01
	3.	Farmyard manure	0·34	0·68	1·02
	4.	,, ,, and artificials	0·4	0·67	1·07
	5.	No manure	0·28	0·69	0·89
	6.	Lime	0·3	0·66	0·96
	7.	Bacterized peat and lime	0·33	0·7	1·03
Not watered	8.	,, ,,	0·29	0·56	0·89
	9.	No manure	0·3	0·6	0·9
	10.	Farmyard manure	0·29	0·63	0·92

In both the watered and unwatered plots farmyard manure gave the heaviest plants, and where bacterized peat was used on the watered plots it had a good effect, but not so great as farmyard manure, especially when assisted by artificials. On the unwatered plots the bacterized peat actually diminished the yield. The peat plus lime on the watered plots was about equal to the farmyard manure plots.

The greatest average weight of roots was given by the peat in conjunction with lime: next came the unmanured crop, followed by farmyard manure. There was less difference between the weights of roots than between the total weights, which points to the fact that the greatest difference was in the foliage. Apparently the watering assisted the action of the peat as well as that of the farmyard manure.

EXPERIMENTS IN 1915.

Similar experiments were carried out this year with further consignments of bacterized peat, using radishes both under glass and in the open, and turnips in the autumn.

The growth of the radishes was retarded by the peat but the turnips grew much more rapidly at first and appeared taller and greener. Considering the weight of the roots produced, the effect of the peat appeared to be negligible. The failure to obtain a striking increase cannot be attributed to lack of water and the results do not justify the assumption that the peat contained 4·3 per cent. of nitrogen as previously stated. A dressing of 1½ tons per acre, the amount applied in this year's experiments, would be equivalent to the heavy dressing of 5 cwt. of nitrate of soda per acre assuming only half of the nitrogen to be available. These considerations strengthen the belief that the bacterized peat is of very variable composition.

At the present price of £10 per ton, the bacterized peat is inferior to farmyard manure, 20 tons of which can be delivered at a cost of £8, producing a greater yield than can be obtained by the application of 1 ton of the peat.

Mixtures of Liquids and Solids.

Where a quick and handy method of determining proportions of mixtures and the specific gravity of the component parts, etc., is desired, the following will be found very useful in dilution and mixing problems outside the laboratory of the sugar-house:—

A = volume of liquid or solid at low sp. gravity.
B = sp. gravity ,, ,, ,,
C = volume of liquid or solid at high sp. gravity.
D = sp. gravity ,, ,, ,,
E = volume of mixture.
F = sp. gravity of mixture.

$$A = \frac{C\,(D - F)}{F - B} \text{ or } A = \frac{(E - A)\,(D - F)}{F - B}$$

$$B = \frac{F\,(A + C) - CD}{A}$$

$$C = \frac{A\,(F - B)}{D - F} \text{ or } C = \frac{(E - C)\,(F - B)}{D - F}$$

$$D = \frac{F\,(A + C) - AB}{C}$$

$$E = A + C$$

$$F = \frac{AB + CD}{A + C}$$

In all these calculations concerning specific gravity it must be noticed that the quantities must be worked as volumes, not as weight.

In adding a solid to a liquid, the weight of the solid must be transposed to volume for finding the specific gravity of the mixture, and other quantities transposed whether given or found.

F. C.

The American Cane Sugar Industry.[1]

I. Hawaii.

GENERAL.

The Hawaiian Islands have been governed as a territory of the United States since 1900. The islands proper consist of a group of 12, of which eight are inhabited; their distance from San Francisco is 2100 miles and from Manila 4700 miles. They consist of craters built up from the bottom of the ocean by outpoured lava, the bottom being from 15,000 to 20,000 ft. deep, while the islands rise to mountainous heights ranging from 4030 ft. in Oahu to 13,825 ft. in Hawaii.

The warm trade winds blow continuously from the north-east for nine months in the year, and striking the high mountain tops their moisture results in continuous and heavy rainfalls, the precipitation often exceeding 200 ins. per annum. On the windward side of the island of Hawaii this rainfall is abundant for plantation purposes, and cane is grown freely without irrigation. But on Kauai, Oahu, and Maui there are practically no cane lands on the windward side, so that practically all the sugar cane of these islands, as well as that on the leeward side of Hawaii, is grown by irrigation. Hawaii has an abundance of sunshine and humid heat, though not so much as Cuba. The latter is surrounded by the warm gulf stream, whereas Hawaii lies within a cooling ocean current; the temperature as a consequence only ranges from 60° to 85°, with an average of about 75°.

Kauai at the extreme north-west end of the main group is the smallest of the four sugar-producing islands (Kauai, Oahu, Maui, and Hawaii). It has an area of 547 square miles, being 25 miles in length and 22 miles wide. Its population in 1910 was 23,744. There are 11 plantations in the island, eight having sugar factories. Of the cane grown 95·66 per cent. was irrigated in 1914, there being 42,697 acres planted.

Oahu has an area of 598 square miles, being 46 miles in length and 25 miles in width. Its population in 1910 was 81,993, the largest for any of the group; the city of Honolulu is on this island. There are ten plantations in Oahu, seven having sugar factories. More than 98 per cent. of the total of 40,352 acres (1914) in cane is irrigated. For the crop of 1914, 20,730 acres were used.

Maui has an area of 728 square miles. It is 46 miles in length and 30 in breadth. It had a population in 1910 of 28,623. It possesses seven plantations and sugar factories, with over 50,000 acres planted to cane. For the crop of 1914, 19,432 acres were harvested, and 89·82 per cent. of it was irrigated.

Hawaii is the largest island of the group, having an area of 4015 square miles.[2] It is 90 miles in length and 74 miles in width. Unlike the other islands Hawaii is still in the making, through the outpourings of its active volcanoes; its two highest peaks being each more than 13,500 ft. above sea level. Its population in 1910 was 55,382. There are 24 plantations on the island, of which 23 have factories; most of them are on the windward side of the island, where the rainfall is abundant. The 23 factories have 93,125 acres available for cane, and of this acreage 41,364 were harvested for the 1914 crops, while there were in addition 11,153 acres of outside planters' cane.

---

[1] Abstracted from "The Cane Sugar Industry" an inquiry into the agricultural, manufacturing, and marketing costs in Hawaii, Porto Rico, Louisiana, and Cuba, by the United States Bureau of Foreign and Domestic Commerce. Miscellaneous Series, No. 53, Department of Commerce, Washington (See *I.S.J.*, 1917, 359).

[2] Or the size of Devonshire and Cornwall combined, and rather less than that of Jamaica —Ed, *I.S.J.*

The estimated population of the islands in 1915 was 223,256. Of this number the Caucasian race comprised nearly 22 per cent., Chinese, Japanese and Filipinos over 58 per cent., while those of the Hawaiian race were over 17 per cent.

In the application of scientific methods and in the securing of results, the cane sugar industry of the Hawaiian Islands will bear comparison with any agricultural or mechanical industry in the United States. Unlike farming operations in the States, there is no period of rest or suspension of agricultural operations. Preparing, planting, irrigating, fertilizing and cultivating, and on some plantations harvesting and manufacture, continue the whole year round, owing to the fact that two or three crops, each of a different year of harvesting, are being cared for at the same time. And sugar forms in value about nine-tenths of the agricultural produce of the islands. Why this should be so when other food products might be produced with much less effort and expense is explained by a study of comparative values. The average value of all the sugar produced on all the plantations for the 1913-14 crop was $432·14 per acre, the highest being $796·02 and the lowest $157·14. When this is compared with the values of farm products in the United States where the best, beet sugar, was in 1915 just under $150 per acre, potatoes $58·79, and cereals about $16 per acre, it will be seen that the Hawaiian planters have a strong incentive to stick to sugar production and neglect the cultivation of other food products.

The Hawaiian sugar planters who comprise 47 corporations are organized as the Hawaiian Sugar Planters' Association. Under the direction of this association there were created (1) the sugar experiment station, (2) the bureau of labour and statistics, and (3) the Sugar Factors Co. The most important of these has been the experiment station which was inaugurated in 1894. "Since its inception it has had on its staff scientists of world-wide reputation, such as Dr. WALTER MAXWELL, an agricultural chemist of the U.S. Department of Agriculture, its first director; C. F. ECKART, the noted specialist on soils, fertilizers, and the propagation of seedling cane varieties; F. MUIR, the entomologist, whose successful search of the tropics of the Orient for the cane borer parasite arrested widespread cane destruction; and NOËL DEERR, the sugar technologist, and author of the accepted textbook on the agriculture of the sugar cane, the manufacture of cane sugar and the analysis of sugar-house products. H. P. AGEE, formerly of the State of Louisiana Experiment Station, is its present director, and it has had a number of other scientists of distinction. After years of technical service in Hawaii NOËL DEERR was invited by the Government of Cuba to take up similar work in that country."

The station has a staff of five entomologists, two pathologists, two sugar technologists, four chemists, and three agriculturists. It has issued 78 technical bulletins, 44 of which relate to agriculture and chemistry, 13 to entomology, and 12 to plant pathology and physiology. It has 135 acres devoted to field experiments covering a wide range of subjects. In order to produce cane of commercial promise it propagated, from 1906 to 1915 inclusive, 15,721 seedling varieties. The planters assert that the position of Hawaii as the most advanced sugar producing country of the world is mainly due to the successful efforts of the experiment station in putting into practice the best methods of fertilizing and cultivating sugar cane, combined with improved methods of harvesting and milling.

The principal function of the Sugar Factors Co. is to act as sales and transportation agent for the plantations.

THE PRODUCTION OF SUGAR CANE.

Preparing and Planting.—Most plantations have expenses for clearing; this operation is necessary on new land, and includes the removal of trees and stones, and the gathering and burning of brush. The land is then broken up by steam ploughs, which turn the earth from 18 to 36 in. deep, and break and pulverize the soil finely. Steam ploughs are used on old as well as on new land, so as to thoroughly loosen the soil. The average cost works out at $3·66 per acre. Where steam ploughs cannot be operated, mule ploughs are employed at a cost of about $2·22 per acre. After the land is ploughed, cross-ploughed, and harrowed, the furrows in which the seed cane is planted, and the water courses on irrigated plantations are marked by field surveying, and ploughed to a depth varying from 24 to 32 in. by a double-decked mouldboard plough. The cane rows are generally 5 ft. apart, and usually follow the contour of the land so as to assist irrigation. Lateral ditches are cut at intervals of 50 ft. to lead the water into the furrows. The cane is planted by placing one continuous row of tops in the furrows, end to end and almost touching, these tops being obtained when the ripened cane is fully grown and harvested. The cost of the seed on 16 plantations averaged $1·78 per acre, while the entire cost of preparing and planting is given as $17·75 per acre, or 39·68 cents per ton of cane.

Irrigation of Cane.—The furrow system of irrigation is in general use on the Hawaiian plantations. The water from the main ditch is diverted by lateral ditches, and carried to the furrows in which the cane is planted. During the first crop the water runs along the cane rows; in ratoon crops, which are hilled up, the water runs between the rows. On irrigated plantations, after the cane is planted, a rivulet of water is turned on until the furrows contain 3 or 4 in. of water. A light covering of earth is placed on the cane tops, and within a week green cane shoots appear above the ground. Irrigation is continued for a long period, but is stopped when the cane flowers. DEERR states that "such cane is usually harvested from three to six months after flowering, and during this time little or no growth takes place, the cane actually evaporating its own water." The same writer reports that as a general figure 1000 lbs. of water are required per lb. of sugar produced.

The cost of irrigation averages $67·91 per acre, being $1·42 per ton of cane, and $11·16 per ton of sugar produced; but then the production per acre averages no less than 47·8 tons of cane and 6·1 tons of sugar. This large production is, however, due not to irrigation alone, but also to the scientific use of commercial fertilizers, selection of cane, and continuous cultivation, combined with favourable climatic conditions.

Cultivation.—Under the heading of cultivation is included the operations of weeding and hoeing, cutting back, hilling up, and stripping. While use is made of animal-drawn implements on unirrigated plantations, the work on irrigated ones has to be performed by hand and with hand implements. On a large unirrigated plantation having a heavy rainfall, and rank weed growth, and managed by a scientist, the destruction of weeds and grass is accomplished by the use of arsenic sprays between the rows of cane, this being an economical substitute for a large amount of hand hoeing and implement cultivation.

The flowering season for cane is during November and December. Cane cut early in the year will flower that same year, and will have to be harvested after a 12 months' growth; such cane is termed short ratoons. By allowing the cane to grow till June, and then cutting it back, it can be carried over the flowering season of the first year, and will flower in November of the following year, thus giving a 17 to 18 months' period of growth from the time it was cut back till it flowers, and a total period of growth of not less than two years by the time it is harvested: such cane is called long ratoons.

In the operation of hilling up, small ploughs are used to loosen the soil between the furrows, after which the hilling up is usually done with a double mould board plough or else with hand implements. The practice of hilling up is general, as it is regarded as an aid to the growth of ratoons through the aërating of the soil. On some plantations stripping is done twice, the first between January and June when the bottom leaves and weeds are removed and a spring dressing of fertilizer is applied. The second stripping is done at times when work is slack but labour has to be employed. This operation makes harvesting easier and lessens the danger from fire. It is favoured on unirrigated plantations, but on irrigated ones in the warmer and drier belts it is considered by a large number of managers an unnecessary expense and detrimental to the cane.

In Hawaii it is the custom of plantation managers to enter into "Cultivation Contracts" with groups of their employees for the work necessary to produce the cane after it has been planted by the company or from the stool if ratooned. This system has proved mutually satisfactory to the companies and the workmen. The latter have the incentive of greater earnings than the labour rates of $20 per month of 26 days, and the company has the advantage of little or no constant supervisory expenses, knowing that the contractors will do their utmost, as the greater the number of tons of cane produced the greater their earnings. As an instance, on one plantation the earnings of the labourers by this method came to $28·89 per month of 26 days, while the benefit to planters is revealed from statistics to be equally favourable, since on a certain irrigated plantation the average of 14 crops showed that by contract work 51·2 tons of cane per acre were produced, while by day labour 43·29 tons per acre was the result.

Ratoon cane.—In Hawaii canes are seldom allowed to grow beyond second ratoons, though certain plantations have six or more ratoons on exceptional fields. The following table shows an instance of what yields may be obtained when prolonged ratooning is practised under favourable circumstances. This table is typical of Hawaiian experience.

Fields	Results per Acre		Tons of Cane per ton of Sugar	Per cent. Sucrose in Cane
	Net tons of Cane	Tons of Sugar		
Plant cane (average)	58·65	7·67	7·64	14·67
Long first ratoons (average)	53·09	7·59	7·00	15·74
Lond second ,, ,,	35·09	4·90	7·16	15·59
Long third ,, ,,	34·94	4·86	7·19	15·60
Long fourth ,, ,,	44·75	5·90	7·58	15·08
Long fifth ,, ,,	59·47	7·05	8·43	13·38
Long sixth ,, ,,	45·41	5·58	8·14	14·39
Short ,, ,,	37·13	5·20	7·14	15·89

For all the fields the average period of growth was 611 days or a little over 20 months of 30 days each.

Fertilization.—How greatly Hawaiian planters depend on fertilizers as an aid to agriculture is shown from the fact that during the year ending June, 1914, the 37 plantations spent no less than $3,747,079 on fertilizing expenses, an average of $42·62 per acre or 95 cents per ton of cane. Fertilization costs more on unirrigated than on irrigated lands, the average being $48·82 per acre for the former and $40·37 for the latter. Nitrate of soda is used largely on the irrigated plantations, the application reaching 400 lbs. per acre. As the prevailing 24 months' growth implies two growing seasons, the application of manures before each has been found very beneficial. The prevailing practice is to use mixed fertilizers in the first one and nitrate of soda in the second. In addition, a complete fertilizer containing an average of 7 to 10 per cent. each of nitrogen, phosphoric acid, and potash, is applied; the proportions of these ingredients are altered to correspond with the analysis of the soil. As much as 1000 lbs. per acre may be applied though 600 lbs. is a more usual dressing.

Disposal of trash.—In Hawaii there is considerable difference in the methods employed in the use or disposal of trash. The usual practice on irrigated plantations of recent years has been to burn the fields of cane immediately before harvesting. This method gets rid of the leaves, so that the cutters and loaders may have only the bare stalks of the cane to deal with. A committee in September, 1914, stated that after years of experience it was generally conceded that if properly harvested the cane does not deteriorate to any great extent and that the loss from such deterioration is far less than the economic gain from burning; at least 40 per cent. greater efficiency in harvesting is obtained by the preliminary burning. On the other hand a large number of unirrigated plantations on the island of Hawaii leave all the trash on the fields and turn it in as a soil enricher. Another rejuvenator of the soil much resorted to in the Hawaiian Islands is filter-press cake, which is applied as a manure on most plantations.

Harvesting.—Harvesting operations in Hawaii continue from December to September. On a few plantations they are carried on the full 12 months. Owing to the density of the growth of the cane and its tangled condition, machines can not be used in cutting; the cane grows so thick that it is difficult to crawl through the fields. Its height and density prevent the rays of the sun from penetrating to the ground, so that rapid evaporation of the irrigation water cannot take place. With certain varieties the great weight of juice causes the canes to droop and to grow in various directions. Sometimes they lie on the ground with the ends turned upward, and in the fields where the stalks grow to a length of 24 ft. the height of the tops above the ground may not exceed 12 ft. As a consequence cane is cut entirely by hand.

Transportation to the mill is effected in various ways. On some estates portable track of a 3 ft. gauge is used, along which cars are hauled by teams or run by gravity if the contour of the land allows. On others cane is hauled on sleds to flumes and sent thereby to railroad cars. Where the cane is grown on hillsides below the level of the factory it is often hauled in bundles up a wire rope. One factory hauls up its cane from below by means of two steam-plough engines fitted each with 3000 ft. of steel rope, the hauling capacity of which is two cars loaded each with six tons of cane.

(To be continued.)

Owing to the shortage of sugar, the General Medical Council in London has taken action with reference to preparations of the British Pharmacopœia containing that ingredient, and has withdrawn from the list a number of compounds which pharmacists and druggists are finding a difficulty in manufacturing.

There is a glut of sugar in the East, due to the lack of shipping, and markets are in a precarious condition in Java, where 600,000 tons of sugar are held by speculators who are reported to have lost $12,000,000 over their deal. The question of finding vessels for transporting this large accumulation of sugar is receiving the close attention not only of the Allied Governments but also of the U.S. authorities, and it is hoped that some means will be found this autumn to obtain at least a portion of it for Western consumption.

Jamaica.

Department of Agriculture Report for 1916-17.

The report for the year ended March, 1917, of the Department of Agriculture, Jamaica, prepared by the Director of Agriculture, Mr. H. H. COUSINS, states that the chief feature of the year in relation to the agricultural interests of this colony was the hurricane in August, 1916, which practically swept the whole island from east to west, so as to destroy the whole banana crop and do a good deal of damage to the sugar canes. In spite of this, the hopeful expectations as to the sugar industry were realized, due to the favourable weather and the enterprise of the planters, so that the largest crop of sugar since 1884, over 28,000 tons and valued at over £500,000, was exported from the island. As this was accompanied by 18,000 puncheons of rum worth £350,000, the sugar industry must be credited with a contribution to the exports of 1916 more than five times that recorded in the year before the war.

"Owing to the hurricane," writes Mr. COUSINS, "the canes were somewhat damaged last August and the crop for the current year is not expected to be so large as had been anticipated, but a considerable crop of sugar will undoubtedly be produced. Owing to the state of the rum market and the embargo on the importation into the United Kingdom, efforts have been made to reduce the output of rum by making as much sugar as possible. The larger estates have reboiled the molasses and obtained an addition of 'Second Sugar' so as to reduce the amount of material sent to the distillery. Owing to a combination of efforts on the part of the planters in Jamaica, the Island Government and the West India Committee in London, arrangements have been made for our rums to be shipped to England for making munitions at the price of 2s. 4d. per gallon of 40 o.p. spirit, f.o.b., Jamaica. It is estimated that one million gallons of local spirit will be available and that the planters will by this arrangement secure £120,000 for rums otherwise unmerchantable so long as the embargo lasts in the United Kingdom. England will also be enabled to save 10,000 tons of barley or other grain besides economizing in coal and labour for the manufacture of spirit required for the making of munitions.

"The Legislature having accepted the scheme of Sir FRANCIS WATTS, Imperial Commissioner of Agriculture for the West Indies, for the financing of sugar factories by the general revenues of the island, a good deal of interest in sugar projects is now being exhibited by planters and landowners favourably situated for large developments. The special advantages of St. Catherine, which were indicated in my last report, have been confirmed by those concerned and business projects for the establishment of a large sugar factory at Spanish Town are now under active consideration. The general attitude of the sugar planters is for the present one of hopeful expectancy. Satisfied to make all the money possible under the present very favourable conditions, they propose to postpone any large investments in machinery until the '*after the war*' conditions have been disclosed. The Report of Lord Balfour's Commission is considered to be a favourable omen for Imperial preference and the establishment of a profitable market in England for Colonial sugar after the war. There are, however, difficulties to be faced, and the planters are well advised in view of past experiences to reserve their decision as to enlarged operations until the position as to the security for the future of our sugar industry has been established.

"One of the difficulties to be faced in some cases is that of the future of rum. Under conditions of efficient management 1 ton of sugar will yield 140 gallons of rum 40 o.p. Fancy rums selling at 3s. 6d. to 8s. per gallon are therefore equivalent to sugar at £24 to £56 per ton. It is a crucial question for a small estate with a limited output of canes, which has hitherto depended on its rum crop, to decide whether 'after the war' it will pay better to continue the old system of rum manufacture or to centralize with the neighbouring estates and to co-operate in the manufacture of sugar on a larger scale with one-fourth proportion of 'common, clean' rum. It is doubtful whether there is any one capable of predicting at the present moment with any certainty as to the prospects of fancy rums from Jamaica after the war and in such cases I have advised the policy of 'wait and see' before a decision is made.

"That our canes in Jamaica are capable of yielding good returns with modern machinery has been well illustrated at Morelands Estate in Vere where chemical control has been recently established. A return of 1 ton sugar from 8⅓ tons of cane has been obtained with a recovery of 1 gallon of rum at 40 o.p. for every 18 lbs. sugars in the waste sent to the distillery. The factory manager at Morelands having been trained at the Government Laboratory, I naturally take some pride in this record. Such a result as this would indicate that the returns recorded for the Antigua and St. Kitts central factories can be equalled in Jamaica in factories less than a third of their capacity."

Except for the distribution of cane tops, the work of experimentation on the estates was suspended during the year under review, owing to the absence of the staff on war service.

Borers and cane-fly pests were troublesome in some sections of the country. The presence of the sugar cane leaf hopper (*Stenocranus saccharivorus*, Westw.) was the chief entomological problem of this crop, it being present on an estate in Vere in highly destructive numbers. During the early autumn the generally excellent rainfall enabled the hoppers to be checked to a considerable extent by a parasitic fungus, but the prolonged drought of December to March following resulted in the wholesale development of this pest, which swarmed upon the young cane practically unchecked. Attack at this stage leads to a decrease in the number of canes per stool, and it is conservatively estimated that the loss to this estate alone must approximate to £1500 per crop.

Unfortunately, information regarding this pest and its parasites is decidedly lacking in entomological literature. An investigation is now being conducted, but at present it is considered that the solution of the problem lies in the finding of efficient natural controlling agencies along the lines of Hawaiian and Trinidad practice for *Perkinsiella* and *Tomaspis* respectively, as cultural difficulties stand in the way of trapping and spraying in the young cane.

According to WILLETT & GRAY a sugar beet factory has been established in the southern part of the province of Buenos Ayres, where soil and climatic conditions are said to be most favourable to the growth of this plant. It will be interesting to see whether this venture proves more successful than the solitary beet sugar scheme at Maffra in Australia; the conditions seem somewhat analogous.

Lamborn's Market Report points out that black stroop molasses is now selling in the American coast markets on the basis of 24 cents per gallon, as against the highest average prices of 5 to 6 cents per gallon ruling for many years. This enormous advance in price is due to its present value as a producer of alcohol and in the manufacture of smokeless powder. In ordinary times in Cuba, Porto Rico, and other island districts, the producers are glad to accept 1½ cents.

Review of Current Technical Literature.[1]

DETERMINATION OF THE LIME REQUIRED FOR THE PARTIAL STERILIZATION OF SOILS. *H. A. Tempany. W. I. Bulletin, 1917, 16, 145-151.*

It has recently been shown by Messrs. HUTCHINSON and MACLENNAN[2] that one of the results of the application of caustic lime to soils is to effect their partial sterilization to an extent analogous to that produced by heat and antiseptics. They have published a method of measuring the amount of lime necessary to cause the effect in question, this being based on adding increasing quantities of lime to 100 grm. lots of the soil mixed with water and contained in bottles, while shaking at intervals, the filtrate from each being titrated with N/50 acid, using phenolphthalein as indicator. On then plotting a curve with the number of c.c. required to produce neutrality as one ordinate, and the corresponding weight of lime added as the other, a change in the slope occurs just at that point at which partial sterilization takes place, this being termed the "transition point."

These workers have noticed a rather remarkable effect. This is that in the method elaborated by them, indication of the occurrence of the transition point can be obtained from the degree of flocculation of the soil compounds suspended in the water, this, in fact, being susceptible of measurement by noticing the time taken for the filtration of a definite volume of the water.

On applying the above described method, Mr. TEMPANY experienced difficulty in the filtering and washing stages, especially when examining heavy soils from the Leeward Islands, and so has modified it as follows:—

> Portions consisting of 50 grms. each of air-dry soil are placed in wide-mouthed stoppered bottles of about 600 c.c. To each of these lots of soil, weighed amounts of lime, increasing in quantity from 0·1 to 0·5 grm. CaO, are added, and thoroughly mixed with the soil. To each bottle 25 c.c. of water are added, the stoppers inserted, and the jars thoroughly shaken until their contents have become more or less uniformly distributed over the sides and bottom, being then allowed to stand for 18 hours. At the end of that time, 275 c.c. additional water are added to each jar, and the whole allowed to stand until the suspended soil has settled out; 100 c.c. of the supernatant liquid are then pipetted off and titrated against $\frac{N}{50}$ hydrochloric acid, using phenolphthalein as indicator.

Working in this way, he found that the transition point is reached with some soils when an application of 0·16 per cent. of lime has been made; while in the case of others the quantity necessary to produce partial sterilization is greater. Comparison of the numerical data with the results obtained in respect of turbidity confirmed the statement that this factor gives a reliable indication of the end-point of the reaction in almost all cases.

Messrs. HUTCHINSON and MACLENNAN have moreover shown that a close correlation can be observed between the laboratory results and the data obtained from application of the theoretically indicated amounts of lime required to produce partial sterilization in the field. Experiments are now being carried out by Mr. TEMPANY to ascertain the correlation between laboratory results and tub experiments, the results of which will be reported in due course.

In general, the method appears likely to possess special value as a means of obtaining information regarding the biological activity of soils in certain directions. At present its rationale is not very clear, but would seem to be that when insufficient lime has been added to the soil to effect partial sterilization, the action of the putrefactive bacteria of the soil resulting in the liberation of carbon dioxide leads to the neutralization of a portion of the lime which has been added to the soil; when, on the other hand, sufficient lime has been added to the soil to effect partial sterilization, liberation of carbon dioxide is inhibited. Calculation of the total amount of lime present in solution at the different points will show that it is always considerably below the total amount added to the soil. This is no doubt due to adsorption of lime by soil colloids, since the increase in alkalinity, especially after the transition point has been reached, indicates the existence of a linear relationship between the total amount of lime added to the soil and the quantity passing into solution. The actual slope of the curve will vary in individual cases, and gives an indication of the adsorption power of the soil.

---

[1] This Review is copyright, and no part of it may be reproduced without permission.—(Editor, *I.S.J.*)

[2] *Journal of Agricultural Science*, 7, 75.

RECOVERY OF POTASH FROM BEET SUGAR FACTORY MOLASSES AND STEFFEN'S WASTE WATER. *H. E. Zitkowski. Journal of Industrial and Engineering Chemistry, 1917, 7, 692-694.*

Even prior to the war the recovery of potash and other constituents capable of being utilized from molasses and the waste waters from Steffen's process was the subject of serious investigations; but now the abnormally high prices prevailing have brought about renewed efforts in this direction. An account is here given of the experiments that have been carried out in beet sugar factories of the United States, and it is shown that the recovery of potash from these products is a comparatively simple and perfectly feasible problem.

Practically all the potash originally present in the raw beet juice finally passes into the molasses, in which it amounts to about 4·66 per cent. (K_2O). As the average production of molasses in the States is from 5·5 to 6·0 per cent. on the beets, with a 6,000,000 ton crop, the total potash in the molasses will reach between 15,400 and 16,700 tons. Of the total molasses production, about 10 per cent. is fermented, and the vinasse or spent residue is concentrated and usually enters the fertilizer trade, so that the potash present is not lost to general economy. About 40 per cent. is used for the preparation of the stock feed by mixing with beet pulp or other absorbent, and in this case the potash is recovered in proportion as the manure from the stock is distributed on the arable land. The remaining molasses production, perhaps 45 per cent. of the total, is desugarized by Steffen's process, and it is this portion that has offered the possibility of recovery in commercial form in the sugar factories.

After the removal of the insoluble tricalcium saccharate, a filtrate, known as "Steffen's waste water," is obtained, and it contains practically all the potash originally present in the molasses treated. In some isolated instances this water is added to that with which the land is irrigated, but this is an uneconomical and uncertain method of utilization. Efforts have been made to effect a better recovery of the valuable constituents, principally potash, but also phosphoric acid and nitrogen. It has been found feasible to concentrate the water to about 55 per cent. in a multiple effect and subsequently to dryness in a vacuum drum dryer, the resulting product containing 10-12 per cent. of potash (K_2O) and 5 per cent. of nitrogen. However, the residue is so hygroscopic that it becomes fluid on exposure to the air for a very short time, but mixing it with dried slaughter-house wastes, which incidentally are deficient in potash, apparently overcomes the difficulty, the two materials complementing one another. By charring the evaporated waste water a crude ash is obtained, containing 30-35 per cent. of potash (K_2O), but no nitrogen, from which a more or less pure salt may be crystallized, and with prices for potash at their present abnormally high value this procedure would appear to prove justifiable, in spite of the high cost of evaporating the large volume of water and the considerable equipment involved.

Review of Current Technical Literature.

EXPERIMENTS ON THE APPLICATION OF ELECTRICITY TO PLANT PRODUCTION. *Ingvar Jorgensen.* *Journal of the Board of Agriculture, 1916, 23, No. 7, 671-672.*

Experiments on the effect of overhead electrical discharges on crops were continued in 1916, oats being grown under this treatment at Lincluden Mains, Dumfries, on two plots each 1¼ acres lying side by side, one of them receiving the electric discharge, the other being used as the control. The season was a particularly dry one, accompanied by a scorching sun, and as the soil is of a very porous nature the conditions were not conducive to a heavy crop.

From the early stages of growth the crop on the electrified area showed a marked superiority in comparison with that on the control area, and did not suffer from the prevailing drought to the same extent. The discharge was run for 557 hours during 108 days, i.e., an average of five hours a day. The two crops when ready for harvesting were cut, threshed, and weighed separately. The weights of the two crops are given below, and show that the electrified, as compared with the non-electrified, showed the remarkable increase of 30 per cent. in grain and 58 per cent. in straw :—

	Total Grain. Lbs.	Total Straw. Lbs.	Increase of Grain. Per cent.	Increase of Straw. Per cent
Electrified	1309	2476	30	30
Control	1008	1572	—	—

An analysis of the grain and straw from the two crops was undertaken at the University of Leeds. The figures obtained for the experimental and control crops showed practically no difference apart from those accounted for by experimental error. Feeding experiments are needed before it can be concluded with certainty that the discharge has been without effect on the food value of the oats, but it is extremely unlikely that any difference of this kind would be demonstrated between the two crops.

A BACTERIAL TEST FOR PLANT FOOD ACCESSORIES (AUXIMONES) IN "BACTERIZED PEAT." *W. B. Bottomley.* *Proceedings of the Royal Society, 89, B., 610*

Prof. BOTTOMLEY claims that the nutrition of a plant depends, not only on the supply of mineral food substances, but also upon the presence of certain accessory food substances, or auximones,[1] very small amounts of which are sufficient to satisfy the needs of the plant. Hitherto the only means of demonstrating the presence of these auximones has been their action on the higher plants. Experiments showed that the auximones in bacterized peat produced an increase in soil nitrification, which suggested that liquid cultures of the nitrifying organisms might provide a test, and it was found that a scum was always formed on the surface of the liquid whenever the auximone was added to the crude nitrifying culture from soil. The organisms forming the scums are, as yet, unidentified, but they are widely distributed in soil, and easily obtained. Again, the amount of scum formed was found to increase progressively with the quantity of auximone present above a certain minimum. More extensive tests showed that the scum formation is due to the specific action of auximones, and that the accessory substances concerned with animal nutrition were also found to induce scum formation. Thus, it is evident that the scum-forming organisms can serve as a qualitative test for food accessories in general. Having the indicator for auximones, other material can be examined for their presence.

Auximones were found in the root nodules of leguminous plants. The scum-forming organisms require no organic carbon for growth and, like nitrifying organisms, can assimilate atmospheric carbon dioxide by chemo-synthesis. Further, they are obliged to obtain their nitrogen from an ammonium salt, as they cannot make use of nitrates. The plant auximones so far investigated differ from those concerned with animal nutrition in that they are not destroyed within wide limits by heat, as they can withstand a temperature of 134°C. for half-an-hour without losing their properties.

---

[1] See *I S.J.*, 1914, 235, 536; 1915, 96, 117, 192, 516, 577; 1916, 198, 222, 233, 357, 472; 1917, 284.

DESTRUCTION OF *LEPIDIOTA ALBOHIRTA*, A COLEOPTERAN PEST ON CANE IN QUEENSLAND.

E. Jarvis. *Queensland Bureau of Sugar Experiment Stations, Division of Entomology, Bulletin No. 4, 1-14, 1916.*

It was noticed that the larvæ of the grey-back beetle (*Lepidiota Albohirta* Water.), which do a good deal of damage by boring into the rhizomes, are characterised (1) by their extreme voracity; and (2) by their habit of swallowing a large amount of earth which passes unchanged through the body. These two features at once suggest the possibility of killing the insects by poisoning the soil in which they live. The writer has made numerous attempts of this kind using various substances, but wholly satisfactory results have only been obtained with Paris green mixed with damp soil in the proportion of about ½ lb. to a cubic yard of soil.

Such an operation is too costly for practical use in addition to the fact that it presents serious difficulties of manipulation. Better results can be obtained by mixing the earth with poisonous vegetable products, such as the leaves of the Mauritius bean or of the cow pea (*Vigna Oatjang*), which plants also have the advantage of acting as manure. The leaves are treated with a mixture of sugar and water (one part of sugar to three parts of water) and then they are watered with a solution of Paris green and mixed into the soil. Experiments conducted on these lines give entirely positive results: out of 17 larvæ, 10 were dead at the end of the first day, and the mortality reached 100 per cent. a fortnight later. The poisoned leaves of the cow pea have the great advantage of remaining poisonous and attracting the larvæ even when they have been in the ground for a month and are nearly decomposed.

The mortality when arsenious anhydride is used is certainly inferior and as the cost is six times as great as that of Paris green the latter is to be preferred.

CRITICISM OF THE USE OF SUPERPHOSPHATES IN AGRICULTURE.

Nicola A. Barbieri *Gazzetta, 1917, 47, i, 38-51*; through *Journal of the Chemical Society, 1917, No. 655, 111 and 112, Abs., i, 312.*

From the results of a number of experiments the author draws the following conclusions:—The whole of the phosphorus contained in plants occurs in the form of phosphoric acid united with alkalis, alkaline earth, and possibly other mineral bases. When the soluble and the insoluble phosphates are eliminated, the plant contains no trace of any other compound of phosphorus; phytins are consequently lacking. Plants do not contain and do not absorb mono or di-calcium phosphates (superphosphates). Superphosphate exerts a retarding action on the germination of seeds and on the development of plants, and cereals and leguminous plants grown in soil fertilized by means of superphosphate contain less total phosphorus than those from contiguous soil not treated with the superphosphate. Further, superphosphate destroys seeds with which it comes into direct contact. Where mineral fertilization is to be effected, it is best to apply those mineral substances which the plants themselves contain.

DETERMINATION OF GLUTOSE IN CANE MOLASSES AND OTHER SUGAR PRODUCTS.

H. Pellet. *Annales de Chemie Analytique, 1917, 22, 43-47.*

Glutose is not fermented by yeast, and its quantity in cane molasses and other products may therefore be determined by fermenting away all the other sugars present, and then taking the reducing power of the solution. 100 grms. of the molasses are diluted to 600 c.c , 1·5 c.c. of sulphuric acid and afterwards 50 grms. of yeast mixed with water added, and the mixture diluted to 1 litre. It is allowed to ferment for 72 hours. A portion of the solution is treated with normal lead acetate, the excess of lead removed by the addition of sodium carbonate solution, and the cupric reducing value ascertained by the author's method of reduction at 65° C., heating being carried on for 30 minutes, and the cuprous oxide collected, dried, and weighed in the usual manner. In order to convert the weight of cuprous oxide found into its equivalent of glutose, the factor 1·008 is used, this carbohydrate having about one-half the reducing power of invert sugar. Cane molasses may contain from 2·6 to 5·6 per cent. of glutose.

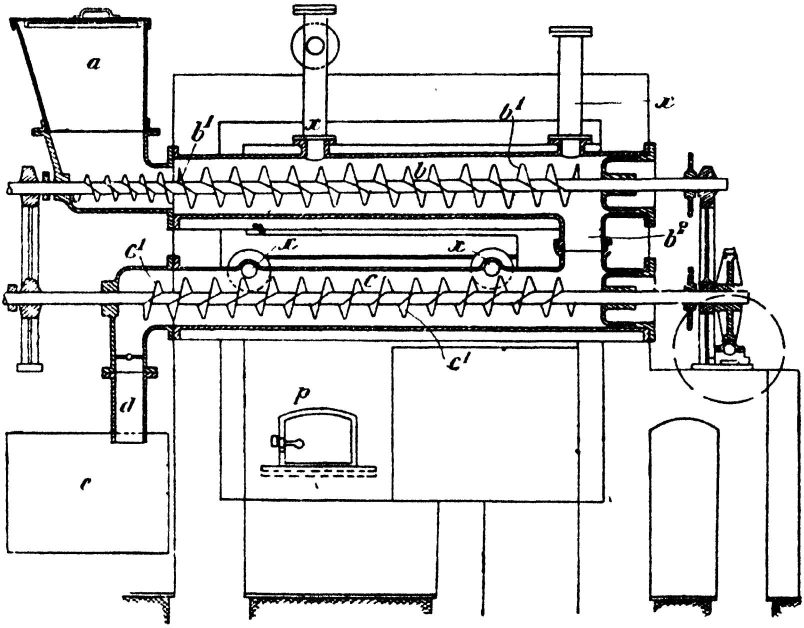
J. P. O.

Review of Recent Patents.[1]

UNITED KINGDOM.

REVIVIFICATION OF USED DECOLORIZING CARBON. *Abraham Wijnberg*, of 567, Heerengracht, Amsterdam, Holland. *104,456* (*10,092 of 1916*). Applied for, July 18th, 1916. Under International Convention, February 25th, 1916, Germany. (Two figures.)

Efforts to revivify finely divided decolorizing carbon[2] by reburning have so far been technically unsuccessful, owing to considerable loss of material in so doing. Moreover in the general type of kiln used for the reburning of animal charcoal, the finely divided carbon adheres to the furnace tubes instead of falling out by gravity, in addition to which the gases generated cannot escape from the vertical tubes. In the apparatus designed to overcome these disadvantages, the material under treatment is continuously moved along in heated cylinders by means of screw conveyors, the gases being drawn off with the finer particles, which are separated out in a suitable trap.



The material to be burned enters through a hopper *a* into the burning cylinder *b* where it is moved forward by a screw conveyor b^1, under continuous mixing or loosening, passing through a conduit b^2 into a second burning cylinder *c* in which it is moved forward in the opposite direction by a second screw conveyor c^1 and discharged through a conduit *d* into a receptacle *e* containing water.

The gases with the finely divided carbon particles that may be carried off by them during the burning process, escape from the burning cylinders through the tubes *x* into the trap or "precipitator" (not shown) in which the carbon particles are trapped and pass into a collecting tank containing water while the waste vapours freed from the valuable carbon particles escape into the open air through a flue. To increase the deposition, steam or water may be injected into the tube leading into the precipitator. The heating of the burning cylinders *b*, *c* may be effected in any optional manner, either by direct or indirect means, the construction represented in the drawing showing the use of direct heat from a furnace or grate *p*. The hot gases passing off after heating the burning cylinders may be used for the preliminary drying of the material to be burned before escaping through the chimney.

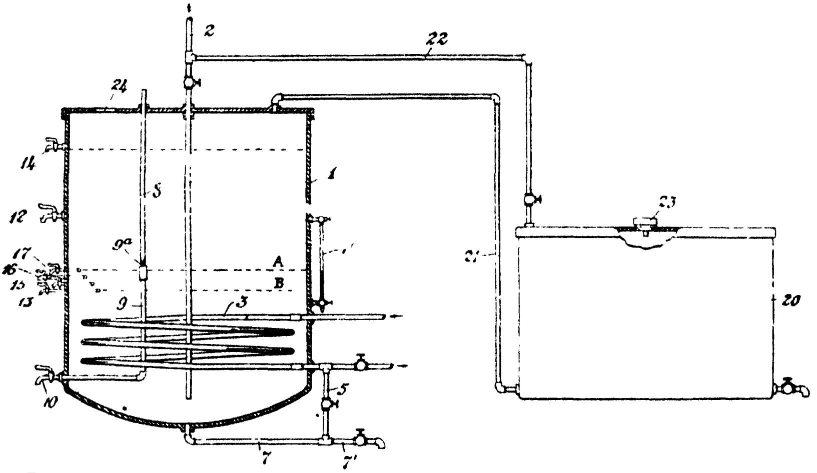
---

[1] Copies of specifications of patents with their drawings can be obtained on application to the following:—*United Kingdom:* Comptroller of the Patent Office, Southampton Buildings, Chancery Lane, London, W.C. (price, 6d. each). *United States:* Commissioner of Patents, Washington, D.C. (price 5 cents each). *France:* L'Imprimerie Nationale, 87, rue Vieille du Temple, Paris (price, 1 fr. 05 c. each). The date given in the heading of United Kingdom specifications is that of the application of the patent.

[2] For patents and other literature relating to "Norit," refer to: *I.S.J.*, 1912, 720: 1913, 248; 1913, 404; 1914, 566; 1915, 70; 1915, 129; 1916, 129, 517.

Process of Purifying Used Lubricating Oil. *Charles J. Skidmore*, of 95, 82nd Street, Brooklyn, New York; and *Peter F. Conerty*, of 340, Birch Street, Queens, New York, U.S.A. *14,781.* October 19th, 1915. Under International Convention, October 24th, 1914, United States. (One figure.)

Methods of merely filtering when applied to the recovery of used lubricating oils may be defective, especially that having been used for internal combustion engines, because of the presence of very finely divided carbon, this passing readily through the generally employed media. It has been found by the inventors, however, that the desired separation can be effected by subjecting the oil to treatment with a liquid heavier than water and incapable of combining with the oil, such being, for example, a solution of an alkali phosphate, say trisodium phosphate, the mixture of oil and solution being well agitated, and afterwards being allowed to settle out, leaving the purified oil in a layer with the solution of the salt below it.



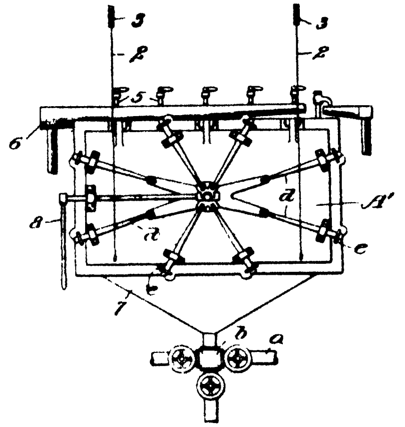
In the figure is shown the apparatus to be employed. It consists of a tank *1* provided with a steam coil *3*, and various taps, *10*, *12*, *13*, *14*, *15*, *16*, *17*, and connected with a storage vessel *20*, from which the oil to be treated may be blown over by means of compressed air, or otherwise transferred. In operating it, the pipe *8* is first screwed into the outlet *9a*, while taps *13* and *14* are opened. A solution of trisodium phosphate, using ¼ lb. of the salt per gallon of oil, is added through *24*, and more water is run in until the level of tap *13* is reached. Now the impure oil is added to the level of tap *14*, the volume of oil to be cleaned and the aqueous solution being thus about equal. A temperature of about 130 F. (55° C.) or higher should be used, in order to cause a good separation.

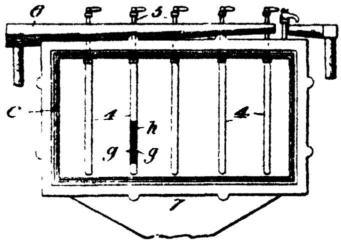
Thorough mixing is effected by passing air through the pipe *2*, or by a mechanical stirrer, or by other suitable means, hot water or steam being meanwhile passed through the heating coil *3*. After this operation, which should last for one hour, the contents of the tanks are allowed to settle out, and for this process to be complete about 24 hours are required. At the end of this time the oil will lie above the level indicated by the dotted line *A*, and the impurities will collect mostly in the space between the lines *A* and *B*, while the phosphate solution will have settled below *B*. Finally the purified oil is drawn off through tap *12*, and afterwards through the pipe *9*, after unscrewing the plug-pipe *8* so as to leave the orifice *9a* open, water being quietly introduced through pipes *5* and *7* into the bottom of the tank to raise the level of the oil and cause it to run off through *9a*. As to the phosphate solution, this may be used several times over before being run away through the line *7*. If the oil is very badly contaminated, it is advantageous to give it a preliminary treatment of about 15 minutes agitation with about one hour's settling, using some of the previously employed phosphate solution for this purpose.

UNITED STATES.

FILTER-PRESS CASING. *Albert L. Genter*, of Salt Lake City, Utah, U.S A. *1,212,933.* Patented January 16th, 1917. (Three figures.)

A shell or casing of any desired dimensions, preferably rectangular as in the illustration, is constructed. Its open side is closable by the head *A'*, secured by hinges at its upper edge to the casing, and adapted to close into the open side of the casing, being held securely locked against a gasket in the contiguous face of the shell during the filtering operation. This is accomplished by some head-locking mechanism, here shown as comprising radial levers *d* on the head engaging loops, or U-bolts *e* on the casing and an operating hand-lever *3*, this mechanism being similar to that described recently.[1]





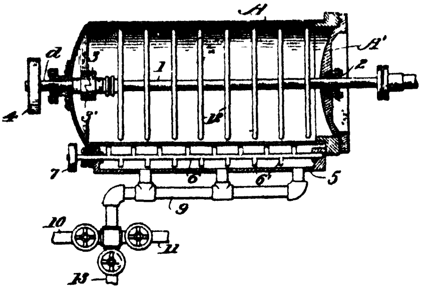
The lower free end or side of the hinged head is connected to a rope or equivalent flexible connexion *2*, which passes over appropriate guide pulleys *3*, and has its opposite end connected to a counterweight by which the head, when unlocked, will be lifted to fully open the side of the shell and give access to the interior of the same and to the contained filter agents *4*. The character of the filter agents used is unimportant, but the construction usually employed in the filter-presses comprises so-called "open-leaf filters" having flexible filtering sides *g*, and an interposed woven wire or foraminous backing *h*. Each filter leaf has an individual outlet pipe *5*, for the filtrate which is forced to the interior of the leaf or frame, and each outlet extends through the top of the shell or casing, and is valve-controlled and is designed to deliver into an appropriate launder *6*, for such further treatment as the filtrate requires.

From the foregoing it will be manifest that one side of the filter shell or casing is secured by hinges to the top of the main portion of the casing, and may be opened or closed as desired in a very simple manner. The sloping of the bottom of the shell or casing permits the clean draining of the shell of any solution remaining therein after the function of the filter leaves or frames has become impaired by reason of the solids accumulating on the filtering sides of the leaves; and it is necessary to open the press and remove the filter frames, or to wash the cake to recover any retained values, it being understood that the several operations of filling the shell with solution, draining therefrom unfiltered excess solution, holding the caked material on the filter leaves with slight fluid pressure, filling the shell or casing with wash water or solution and again draining, are intended to be carried out in the press illustrated, and that these operations are well known in the art, and that they are not claimed by the present inventor.

---

[1] U. S. Patent, 1,015,961.

Filter Press with Removable Filter Leaf Carrier. *Albert L. Genter*, of Salt Lake City, Utah, U.S.A. *1,212,932*. Patented, January 16th, 1917. (Four figures.)



Within the shell or casing *A* the filter leaf carrier is mounted, and may be withdrawn by means of small wheels sliding upon rails. This carrier comprises a hollow shaft *1* and a head *A'* with stuffing box *2*, this head serving as a tight closure for the open end of the tank, after locking by some suitable mechanism, as that described in a previous specification.[1] The filter leaves may be circular to conform with the shape of the casing, and of any suitable construction, as those, for example, having fabric filtering sides and an intermediate foraminous or woven wire backing; while the liquid under treatment will be forced through the filtering sides to the interior of the leaf, and from thence to the hollow central shaft for delivery outside the press. The end of the central shaft *1* has a clutch *3*, engaging with another member on a shaft *d*, provided with a pulley *4*, to which power may be applied to rotate the shaft.

In operation, the solution to be filtered is pumped or otherwise delivered into the shell when the filter leaf carrier is in the position shown. The solution is admitted under pressure through a valve-controlled pipe *11*, into a manifold *9*, having branches which enter the bottom of the trough *5*, at a plurality of points. It is kept uniformly mixed by the agitator, and when the tank is filled the filtering function begins, and it continues with the filter leaves in rotation, until such time as the building up of the filter cakes on the outer sides of the filter leaves makes it necessary or desirable to cease. If the cakes are to be washed to recover any contained sugar, or for other purposes, the excess solution will be withdrawn through a drain-pipe *13*, or otherwise, and a suitable wash-water, under pressure, is admitted to the manifold *9*, into the shell by shutting off the solution supply *11*, and drain-pipe *13*, and opening a valve in the wash-water supply pipe *10*.

After the cakes have been washed, the excess unfiltered material or wash-water is displaced from the shell, and the head *A'*, will be unlocked, and the carrier slid endwise out of the shell over a tank to expose all the filter leaves or frames, and to make it possible to remove the filter cakes (which may drop into the tank) by any well known method and to cleanse, renew, or repair the leaves or frames. As the carrier moves out of the shell or casing, the clutch members *3* and *3'*, separate, one relatively to the other, thereby disconnecting the carrier from the power, and when the carrier is slid back into the shell or casing for another cycle of operation, the clutch member *3*, on the shaft *1*, is automatically engaged with the companion driving clutch member *3'*, and the power thus transmitted to rotate the shaft *1*, and the filter leaves carried thereby, at such speed as may be desired.

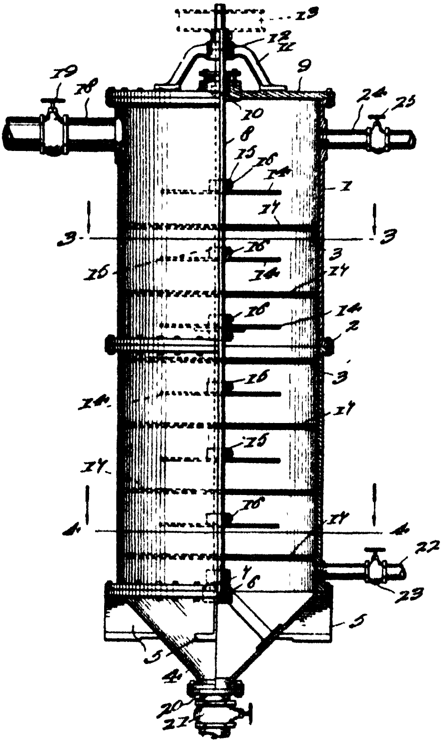
Manufacture of Sugar by Evaporating the Juice to Dryness and Re-dissolving *Oma Carr*, of Asheville, North Carolina, U.S.A. *1,201,936*. Patented, October 17th, 1916. (No figures.)

According to this specification, the mill juice is reduced to a state of dryness in an "atomizer-drier," the sugars re-dissolved from the desiccated mass, and the resulting solution again concentrated to obtain the final product. Preliminarily the mill juice may be mechanically cleaned out and subjected to treatment with lime alone or with a solution of aluminium sulphate and lime (in equivalent proportions to form aluminium hydroxide and calcium sulphate). Water may be used for the lixiviation of the desiccated mass, or 50 per cent. alcohol, and the aqueous solution of the sugars (obtained after recovering the alcohol if this be used) may be subjected to osmosis for the removal of the salts. A variety of manipulations, depending upon the nature of the juice, and the grade of final product desired, may be employed, these being based upon the power of metallic salts to render the organic salts insoluble (the excess of metal being also converted into an insoluble condition) while drying to assist the operation, and afterwards lixiviating with alcohol of suitable strength. Sugars of the "highest purity and whiteness" are claimed to be produced by mechanically cleaning the mill juice, treating it with lime, desiccating in the atomizer-drier, lixiviating with cold 50 per cent. alcohol, recovering the spirit, dissolving the sugars in water, submitting the aqueous solution to osmosis and passing it over animal charcoal (bone-black), and finally concentrating the syrup to crystallization point.

---

[1] U. S. Patent, 1,015,961.

CASCADE SULPHUR BOX. ***Lee J. Foret***, of Lockport, Lafourche, La., U.S.A. *1,208,534*. December 12th, 1916. (Five figures.)



It is intended to provide a means by which the sugar juice under treatment with sulphur dioxide is separated into finely divided sprays or sheets, and thus thoroughly exposed to the action of the gas. A cylindrical box, shown in the figure, composed of a casing *1* is used. It has a spindle *8* fitting into a ball-bearing at *6*, and passing through a stuffing box *10* into another ball-bearing *12*. Secured to the spindle are a series of discs *14*; while attached to the interior of the casing are annular shelves *17* projecting toward the spindle beyond the outer edges of the disc *14*. The gas enters through *22* and escapes through *24*, the raw juice being fed in through *18*, and carried off through the pipe *20*. In operation, the raw juice coming through the main *18* falls on the upper disc *14* and upon the upper shelf *17*, and thence passes through the opening in this shelf *17* and falls on the disc *14* below. Falling over the edge of this disc, it drops on the second shelf *17* from the top, whence it is delivered to the third disc, and so on. The discs being in rapid rotation cause the juice to spread out in thin film-like sheets, and all parts of the juice are particularly exposed to the gases which are moving in the opposite direction to the liquid. By having the discs *14* overlapping the openings in the centre of the annular shelves *17*, the juice is caused to follow a zig-zag course, which course is modified by the centrifugal force imparted to the liquid by the rotary disc from which it falls. Thus, a series of cylindrical or umbrella-like curtains of spray, or thin layers of juice, are formed, through which the gases pass, and by which the bleaching elements are absorbed. By having the shelves *17* made in halves and loosely mounted on the annular ribs they may be readily removed from the apparatus when the disc above is removed; while the discs may be readily taken off the central spindle, when desired, by undoing the set screws *16*.

United States.

(Willett & Gray, &c.)

(Tons of 2,240 lbs.)	1917. Tons.	1916. Tons.
Total Receipts January 1st to August 23rd	1,954,777	2,138,007
Receipts of Refined ,, ,,	—	—
Deliveries ,, ,,	1,965,742	2,037,090
Importers' Stocks, August 22nd	—	104,995
Total Stocks, August 22nd	136,087	258,266
Stocks in Cuba, August 22nd	373,428	418,925
	1916.	1915.
Total Consumption for twelve months	3,658,607	3,801,531

Cuba.

STATEMENT OF EXPORTS AND STOCKS OF SUGAR, 1914-1915, 1915-1916, AND 1916-1917.

(Tons of 2,240 lbs.)	1914-15 Tons.	1915 16. Tons.	1916-17. Tons.
Exports	1,877,022	2,345,886	2,275,189
Stocks	494,407	519,568	507,130
	2,371,429	2,865,454	2,782,319
Local Consumption	49,400	53,200	65,000
Receipts at Ports to July 31st, 1917	2,420,829	2,918,654	2,847,319

Havana, July 31st, 1917 — J. GUMA.—L. MEJER.

United Kingdom.

EXPORTS OF SUGAR.

	MONTH ENDING JULY 31ST.		SEVEN MONTHS ENDING JULY 31ST.	
	1916. Tons	1917. Tons.	1916. Tons.	1917. Tons.
BRITISH REFINED SUGARS :—				
Refined and Candy	172	65	3,693	683
Total	172	65	3,693	683
FOREIGN AND COLONIAL SUGARS :—				
Refined and Candy	52	3	688	10
Unrefined	671	32	1,215	414
Various Mixed in Bond	—	—	—	—
Molasses	70	—	627	17
Total Exports	**965**	**100**	**6,223**	**1,124**

THE
INTERNATIONAL
SUGAR JOURNAL.

No. 226. OCTOBER, 1917. Vol. XIX.

☞ **All communications to be addressed to "The International Sugar Journal," 2, St. Dunstan's Hill, London, E.C.**

Cheques and Postal Orders to be made payable to "The INTERNATIONAL SUGAR JOURNAL," and not to individuals.

☞ **The Editors are not responsible for statements or opinions contained in articles which are signed, or the source of which is named.**

The Editors will be glad to consider any MSS. sent to them for insertion in this Journal and will endeavour to return the same if unsuitable; but they cannot undertake to be responsible for them unless a stamped addressed envelope is enclosed.

Notes and Comments.

Government Control of Sugar in the United States.

With the entry of the United States into the war, Washington authorities realized at once that the control of the food supplies would be of paramount importance in view of the world shortage owing to general scarcity of labour. They have therefore taken immediate steps to form a Food Administration under Mr. HOOVER, the gentleman previously responsible for providing stricken Belgium with rations of food, and he has naturally included sugar amongst the articles of food to be controlled, appointing Mr. ROLPH of San Francisco as his supervisor of the sugar department.

The Food Administrator has now assumed practically complete control of the sugar industry. We understand that a committee of five has been appointed, two of whom will represent the British Food Controller and probably two the American refiners, while Mr. ROLPH will be the fifth and the chairman; this committee will be charged with the task of buying all raw sugars not only for the American market but also for the Allies, though as regards the latter we believe the control is confined to sugar produced in non-British sources in America and does not cover British purchases in Java, which are in different hands. This committee, while fixing prices on an equitable basis for all concerned in the sugar market, will naturally endeavour to let the consumer have the sugar at as low a price as the circumstances will allow. But no fixed retail prices are at present contemplated.

The control of the sugar supply comes into force just when the American refiners are at the end of their stocks of raw cane, and at the moment when annually the American supplies of domestic beet are about to enter the market. Normally this beet has to compete on a market which for nine months of the year is controlled pretty completely by the refining interests, and in order to get in, the beet producer has to market his sugar at a lower price than that of the refiners' imported sugar, the difference being sometimes nearly half a cent per lb.[1] This undercutting of the refiners' price may even lead to the latter withdrawing from the market till the domestic beet is disposed of, when of course the refiners can resume and control operations once more.

In view of this, it is not surprising that the Food Administration have gone at the start to the beet sugar interests and have negotiated with them for a reasonable price for this season's beet. The beet producers have met the request in an undeniably patriotic spirit and have agreed to charge no more than 7¼ cents, New York, f.o.b. cane basis. This, it will be noted, is considerably lower than the then current price in New York of 8½ cents. It of course establishes the price for refined till the beet season is over, and providing the Sugar Committee are successful in negotiating with the Cuban raw sugar producers for a satisfactory price to cover the new Cuban crop, it must be assumed that the price of refined later on will be fixed on much the same basis. The refiners' margin (at the moment of writing) has still to be settled; they were offered 1.35 cents per lb. (almost 6s. 2½d. per cwt.) but are asking for 1.50 cents (say, 6s. 10¾d.). Even if they finally accept the lower figure, they are admittedly receiving a handsome profit. In Germany they used to reckon the margin between 88 per cent. beet and refined at 3s. 6d. per cwt., and, if we are not mistaken, have on occasion accepted as low a figure as 1s. 9d.

One result of the new conditions is that the Louisiana cane sugar producers are contemplating clarifying their output in much greater measure and so making themselves independent of the refiners. A fixed price and a desire to obviate unnecessary transit of sugars in the States will doubtless facilitate their plan and enable them to revive a market for Louisiana yellows, at any rate within the Southern States.

The American Drawback on Export of Sugar.

Having summarized above the latest state of affairs which holds in America, we would now take our readers back to some older events not without interest which held the political arena down to August.

One of the first steps taken this summer as a consequence of the United States coming into the war has been the introduction of a big revenue bill into Congress with the object of providing the means to defray war expenses. The Finance Committee, to whom was entrusted the task of drawing up the provisions of the bill, included as one of its features a clause suspending the drawback on sugar. In the United States, it may be explained, there is no arrangement made by the authorities for refining *in bond*, such as holds in this country. All sugar entering the States is taxed; but if when it has been refined it is exported, a drawback equivalent to the original duty paid is granted by the Treasury to the United States exporters, an allowance which is only reasonable, since otherwise that exported sugar competes on the world's markets saddled with the burden of the United States domestic taxation.

The arguments of those who introduced this clause are perhaps best gleaned from an interesting speech made by Senator **Broussard** of Louisiana in the Senate on August 16th last. He alleged that the drawback, which in 1916 involved the United States Treasury in the refund of no less than $19,801,513 now operated as a bounty for the United States refining trust, and that consequently there was no justification for the Treasury allowing so large a sum to be withdrawn while the present war conditions prevailed. He charged the sugar trust with taking advantage of the abnormal demand from Europe for refined to raise the price of sugar in the States, and thereby to amass excessive profits. He asserted that the American refiners were selling refined for export at a price which was not hampered by the necessity of competing on a free world's market (inasmuch as the supply for British and French Government buyers was virtually restricted to the American market), and thus gave the refiners a reasonable enough return; they however, of course, claimed the drawback of a cent. per lb. when the sugar was exported thus increasing their profit by that sum, and this, the Senator alleged, operated as a bounty for the reason that the American domestic buyers having to compete with overseas buyers for an insufficient amount of sugar were forced to pay a price which was equivalent to the foreign price plus the drawback. In other words, argued the Senator, the refiners were taking advantage of the abnormal demand from Europe for refined sugar to make the domestic consumer pay an additional one cent. per lb. for his supply, with the result that they not only reaped the "bounty" on export, but also secured an additional profit from the home market. He was therefore strongly of the opinion that the drawback should be repealed to the benefit of the United States Treasury, and he was disinclined to admit that its repeal would result in any loss to America of export trade for the reason that during the war, with its drain on shipping, the European demands for sugar could only be met by buying over in America. In other words, if the refiners chose to recoup themselves for the loss of their drawback by charging a higher price to the foreign buyer, the latter would have to pay it if he wished to get the sugar.

---

[1] *Vide* "Concerning Sugar," C. 20.

The argument, it will be seen, is merely an American domestic one; it is tolerably evident that the main object of this attack was not really a feeling of concern for so much Treasury money going out of the country, but was clearly aimed at the refining trust who would appear to have amassed lately considerable profits at the expense not only of the export trade (the Allies) but also of the domestic consumer. Unfortunately the Senator's arguments regarding the drawback were faulty in the extreme, and must have discounted the impression he hoped to make on the Senate with regard to the operations of the trust generally. Elsewhere in this number will be found a contribution from an able pen which demolishes conclusively, if somewhat crushingly, the arguments Senator BROUSSARD thought fit to advance in support of the repeal of the drawback. The drawback, failing a system of *refining in bond*, is necessarily indispensable; and the Finance Committee have evidently on longer reflection come to the same conclusion, for we understand that this clause in the Finance Bill has now been abandoned.

The Sugar Refiners' Point of View.

However, there was a moment when it seemed possible that the Committee referred to might decide otherwise; and the refining interests lost no time in making representations at Washington. They were naturally strongly opposed to the proposal; and they had also the support of the sugar producers generally including the Louisiana planters, as all these feared that the repeal of the drawback might lead to lower prices all round. Their statement to Congress reminded the latter that no foreign country of commercial standing attempts to lay a tax on exports; the United States has one-third excess refining capacity, and so if not legislated out of the world parity it could refine for export one million tons annually without skimping domestic requirements; to repeal the drawback and levy a half-cent excise[1] would destroy the export business without yielding revenue;

---

[1] This excise proposal has also now been abandoned in the interests of the consumer.

foreign countries need not buy refined from the United States so long as there is excess refining capacity elsewhere or washed sugars are available; why, they ask, should the Allies pay a tax of 1½ cents per lb. for the privilege of passing Cuban and foreign sugars through the United States refineries? Even the threat of this repeal has diverted large business to Canada where, they claim, there is 600,000 tons[1] excess yearly refining capacity. Again they claimed that the threatened action in cutting off the United States refined from export has caused a heavy and persistent buying of raws in Cuba by foreign countries for direct consumption, which exactly measures the decrease in refined sugar to be exported this year from the United States. And they finally renewed a suggestion that they be permitted to refine in bond in a manner already accorded by law to other manufacturers, a suggestion that we hope may now be within the bounds of realization.

Impure Sugar in the United States.

So much for the question of the drawback, and its supposed bounty to the refiners. It is clear that whatever gains the refiners have been amassing at the expense of the American consumer are not due to the refund on export of the import duty. But the Senator had another charge to lay at the door of the refining trust which is rather curious reading in view of the well-known policy in the past of the trust to discourage (through the medium of public advertisements) the consumption of any but refined sugar. We in this country during the summer were rather perturbed because we considered that the Sugar Commission was exercising undue caution in the matter of deciding which sugars might be passed direct into consumption and which were too impure to dispense with refining, and as a consequence they had certain sugar refined which might well have gone direct to the consumer, and so have eased the prevailing scarcity. The Sugar Commission, in defence, asserted that much of the raw sugar imported, at all events that from Cuba, was of too dirty a nature to be fit for the consumer, and their spokesman in the House of Commons gave us a picturesque description of the range of impurities both animal and vegetable found in the raw sugar in question. But at least it could be said that the Sugar Commission, if they erred, erred on the side of maintaining the purity of the food supply.

But if Senator BROUSSARD is to be believed, an almost contrary state of affairs has recently been revealed in the States. The sugar refiners who in the past have always in their own interests run down raw sugar (including the old-time brown plantation sugar which polarized 95° or 96°), alleging that it "contained great numbers of disgusting insects which produce a disgusting disease," have lately apparently found that it would pay them to sell to the American consumer just the very raw sugar they prejudiced the public against 20 years ago. They required for the English and French markets seemingly all the refined sugar they could turn out, so they placed some months ago on the American home market a new brand of sugar, an "old-fashioned brown," which they advertized freely in the American press. Some of it was analysed by the Bureau of Standards at Senator BROUSSARD's request, and was found to polarize under 85°! What the remaining percentage consisted of, we are not told, but it certainly was not sucrose.[2]

---

[1] As will be seen on p 444, the Canadian Ministry of Labour's investigations put the total at 200,000 tons only.

[2] If it be true, as the refiners represented at Washington, that they can refine for export one million tons annually without "skimping domestic requirements," it would be interesting to know why they have recently reversed their past policy of making a dead set against all unrefined sugars.

Probably there was an appreciable amount of moisture present; but even allowing for that, the sugar must have contained a considerable percentage of impurity, though how it would compare with the Cuban crystals condemned in this country in respect to physical contamination we are unable to say. But in view of the fact that it has been marketed by, of all parties, those refining houses who have in the past steadfastly set themselves to discourage the sale in the United States of all direct consumption sugars (which, of course, do not pass through their refineries), we suspect that enlightened American opinion will draw its own conclusions as to the importance to be attached to any past, present, or future allegations of the refining interests. We hardly suppose that the American public have appreciated this sugar; in fact we understand that its sale has now been withdrawn. And it is hard to resist the conclusion that if Senator BROUSSARD's charge is at all reasonably accurate, the American refiners have lately been indulging in tactics which may some day serve as a weapon against them and their operations on the American sugar market, supposing that public opinion is roused to take some legislative action, ill-advised or otherwise. It is not so long ago that in the interests of the American consumer the whole sugar tariff was in jeopardy, and who knows that the latter party may not get another innings after the war?

The English Taste in Sugar.

In the course of his speech in the American Congress Senator BROUSSARD paid us the compliment of quoting at length from two of our recent issues[1], where we dealt with the matter of impurities in sugar landed in England and suggested that some at least of the raw sugar imported which was refined might in the prevailing scarcity have gone into direct consumption. He concluded from these remarks that there was a demand on the part of the British for plantation sugar, which the refiners in their own interests were trying to thwart with the aid of the Sugar Commission.

It was hardly the case that the British public demanded plantation sugar, if only for the reason that since they have for so long been accustomed to refined sugar derived mainly from German and Austrian sources, plantation white or washed sugar is still much of a new proposition for them.[2] But those who felt that this latter class of sugar has a considerable future before it welcomed the opportunity which the general scarcity of sugar seemed to offer of enabling the British public to make its acquaintance more widely, and they accordingly deprecated any action being taken which would tend to prejudice the public against this necessarily inferior but perfectly consumable quality. For the public, including the sugar users, have been in the past inclined to look askance on it and in some cases have refused to buy it. In war time however they show more willingness to put up with anything which seems inevitable, and so the present moment is an excellent opportunity to accustom them to the less brilliant qualities of sugar than the refined varieties. For this reason we regret that freight difficulties have interfered with the importation of Java whites during the last twelve months, as these excellent sugars are a good illustration of what direct consumption sugars might be, and if the public took to them they would be the less likely to let their demand after the war revert wholly to refined sorts—a reversion that might have the result of resurrecting the market in this country for German and Austrian refined, since unless there is a large increase in the extent of our refineries, the latter would be unable to cope with the demand and imports from abroad would follow as a matter of course.

---

[1] *I.S.J.*, 1917, p. 245-6; and 294-5.

[2] It is true that even before the war there was a fair business done in this country in Javas, but it was only a small percentage of the total consumption, and some of the import owing to its cheapness was bought for refinery purposes. During 1915 and 1916 the imports from Java were of course greatly increased, and probably about 100,000 tons per year of white Javas went into direct consumption.

If the sugar supply of the British Empire is to be increased, it is bound to be augmented in part by the manufacture of direct consumption sugars, since British sugar planters, if they know their business, will not care indefinitely to confine their output to sugars of low purity destined for the refinery. Hence it appears to us that it is of some moment that the British consumer should have the opportunity of knowingly testing these direct consumption brands, and specifying whether he will create a demand for them or not. We therefore trust that if there is any large importation of white Javas this winter, as we have reason to think there will be, it will be possible for the public to learn the nature of what they are purchasing. We suggest in fact that an endeavour be made to label this sugar suitably in the view of the public purchaser as a direct consumption cane sugar; the precise name may be a matter of deliberation, but one ought to be fixed.

The Case of Cuban 96° Crystals.

But as regards the criticized Cuban raw sugar, it has to be conceded that the objection to refining could not apply, since, as a letter on another page from an old reader (who has been a Cuban raw sugar manufacturer and is now a Boston refiner) shows, the Cuban output is made for the refineries, and is not supposed to be fit for direct consumption. Clearly then the Cuban sugar sold to the Royal Commission was supplied in the belief that it would go to the refineries as a matter of course. Hence no attempt would be made to free it of its physical impurities before bagging. We note that in the opinion of our correspondent, Cuba once assured of a remunerative market for direct consumption sugars would turn them out, but it would require radical changes from the present methods of the Cuban manufacturer. Whether "radical" accurately sums up the degree of change needed is perhaps open to argument; but in view of the undoubted fact that the Cuban output before the war was assured of only one market, that of the United States refineries, it is not surprising if the Cubans have tended to prefer quantity to quality, and have not attempted to produce a higher grade of sugar.

France denounces the Brussels Convention.

At its sitting of August 3rd last the "Bureau du Syndicat des Fabricants de Sucre de France" passed a strongly worded resolution calling for the denunciation of the Brussels Convention before September 1st, and they promptly transmitted this resolution to the authorities, and pressed on the Ministers of Agriculture and of Commerce the desirability of such action being taken. At its sitting on August 17th the French Cabinet, having before it the unanimous advice of the *Commission du regimé douanier*, came to the decision to denounce the Convention, and due notice has accordingly been given to the other signatories to this agreement. The French sugar interests have from the very commencement of the war been averse from any continuation of this international arrangement. They point in particular to the fact that whereas the German and Austrian sugar factories are all intact, the French ones have suffered grievously during the war, and they desire to have a free hand in the future to build up their industry. Expert opinion of course holds that the Convention has fallen through owing to the war, but doubtless in view of the presence in the agreement of neutral countries, the French Government have preferred to take the step of giving notice of withdrawal, as provided for in Article 5 of the Protocol of March, 1912, the withdrawal to take effect on September 1st, 1918.[1]

The Work of the Royal Commission on Sugar Supply.

Elsewhere we give, slightly abridged, the first (interim) Report of the Royal Commission on the Sugar Supply of the United Kingdom, just issued. Unfortunately, this only brings us down to December, 1916, when, owing to the access of the present Government to office, the Commission shed its political head, Mr. McKenna; it is not unnatural then in the circumstances that the latter should desire to set on record the work of the body over which he presided.

The Report naturally seeks to justify *in toto* the whole policy of the Commission. As regards its preliminary operations it may suffice to remind our readers that about two years ago we showed[2] what was the nature of the Commission's attempts at buying sugar—they bought in a hurry, round about the top of the market, about a million tons and when the market subsequently fell, they had to prohibit importation of what would have been cheaper sugar while they disposed of their remaining stocks. Meanwhile the consumer paid the difference.

We notice that the claim is again made that during the greater period of the Commission's operations the selling price of sugar in this country was below that of sugar in New York. As a matter of fact, we believe the contrary was the case; certainly it is the opinion in New York that the price over there has generally ruled lower than in this country.

Since the Report was prepared last December, there has ensued a period of much greater stringency owing to the introduction of unrestricted submarine warfare, and it will be interesting to have the record of the average rate of imports weekly during 1917 which till last December was never less than 24,000 tons. This, we are told, readily allowed the 14 000 tons needed to provide the civil population with ¾ lb. per head per week. But as the ration for some months now has been only ½ lb., which at the same rate would absorb about 9,500 tons weekly, it will be seen roughly to what extent the imports of sugar have been reduced from various causes.

The Sugar Refining Industry in Canada.

According to a report issued by the Canadian Ministry of Labour and reproduced in the *Board of Trade Journal*, the quantity of sugar refined in Canada during 1916 aggregated 345,089 short tons and was of the value of $47,473,114. The output in each of the three preceding years amounted to 303,233 tons, 332,512 tons, and 319,752 tons respectively.

There are six refining companies in the Dominion, and these control eight refineries which are situated at Wallaceburg, Ontario; Kitchener, Ontario; Chatham, Ontario; Montreal, Quebec (two); St. John, New Brunswick; Halifax, Nova Scotia; and Vancouver, British Columbia. Five of the companies refine imported raw cane sugar exclusively; the remaining company refines both cane and beet sugar. The last-mentioned concern was established mainly for the purpose of manufacturing beet sugar, but, during 1916, of a total output of 101,000,000 lbs. from the company's three refineries only 19,000,000 lbs. were from beet sugar. It is stated in Canada that beet sugar can be produced ordinarily at a cheaper rate than cane sugar.

---

[1] *I.S.J.*, 1912, 317. [2] *I.S.J.*, 1915, 448.

Until 1916 the production of Canadian refineries was absorbed by home consumption. Favourable conditions prevailing during that year, however, enabled the refiners to export 26,000 long tons overseas, and up to May, 1917, arrangements had been made for further exports of 35,000 tons of sugar.

The capacity of the Canadian refineries is very much in excess of the demand for sugar for home consumption. Their output represents only about 60 per cent. of their capacity during any one year. The refineries could certainly produce annually some 200,000 short tons of sugar in excess of their present output. The advantage to them of an export trade at satisfactory prices is thus apparent, but, the Report states, it is impossible for Canadian refiners to compete for the United Kingdom market, except when extraordinary conditions prevail.

The Drawback Question in the United States.

There have been many "Sugar Questions" during the last fifty years, some sound, some ridiculous, but this seems to beat them all in eccentricity. The first news that it was seriously proposed, in Congress in the United States, to abolish the payment of drawback on the export of refined sugar sounded incredible, except under the supposition that refining in bond was to be established there as it has been in Europe. But that was not the case. We have therefore to look into the reasons given for such a strange proposal, and we will endeavour to do so from a perfectly detached point of view, not having any axe to grind but with very intimate knowledge, after fifty years of unusually close experience of all the "ins and outs" of the various sugar questions of the past, in which drawbacks played a large part.

A duty on sugar is one way of raising revenue from indirect taxation. It is paid eventually by the sugar consumer. The sugar refiner, who makes the sugar fit for consumption, advances to the Government the duty on the raw material and receives from the consumer the duty on the refined sugar. If the refiner also has an export trade he must receive from the Government a return of the duty which he has paid before he can export his sugar, otherwise he would suffer a dead loss of duty on that quantity of sugar. But in practice he would suffer a more serious loss; he would be actually prohibited from enjoying an export trade, because he would never find buyers abroad who would pay him the price of his sugar plus the American duty on it.

Those are the simple facts—quite ignored by the advocates of what they call "the repeal of the drawback." Now for their (so called) arguments and facts. The real circumstances on which they base their agitation are of course well known. The war has cut off the supply of refined sugar from Germany and Austria, on which the British consumers have been (by reason of the bounties on its production and export) compelled for many years to rely, and Great Britain has therefore been driven to have recourse to New York to fill up the void. This has given the American refiners a sudden and enormous increase in their export trade, which fortunately they have been able to meet owing to their great reserve of refining power. They continue to supply the home consumer as usual with all he wants, and he goes on consuming more and more every year in spite of high prices. The revenue from sugar in the United States, therefore, continues its ordinary course without any impediment. But as the American refiners are now also supplying British consumers with a large portion of their consumption they are paying much larger sums than usual to the Treasury for duty on the raw material necessary for producing both sugar for home consumption and the sugar sent to the United Kingdom. They must on exportation have their duty returned to them. If not they either lose the extra trade or they have to charge the British consumer with the American duty.

Those are the simple facts. What do advocates for "repeal of the drawback" say? Look, they cry, at these enormous sums paid in drawback to the refiners! Look at the loss to our revenue! The simple reply is that there is no loss to the revenue, as we have just demonstrated.

The second cry is more absurd and unfounded even than this one. How grossly unjust it is, say the agitators, that the refiners should enjoy their drawback, "a privilege" which the beetroot sugar producer in the States "is not permitted to receive." The members of the Senate are expected to swallow arguments like this, though surely they know perfectly well that the producer of home-grown beetroot sugar pays no duty, and therefore receives no drawback. They ought also to be perfectly well aware that the beetroot sugar producer enjoys a very comfortable preference (amounting to the whole duty) in his own home market, and therefore would never dream of sending his sugar elsewhere. And yet the agitators tell them that "all domestic sugars are closed out of the foreign market by the operation of the drawback." If that deceives the Senate they must indeed be prepared to believe anything.

The next argument is that the drawback is for the purpose of permitting the refiners to compete on the foreign market where they are selling their sugar, but that, as they are selling their sugar on a market where there is no other seller, the drawback is therefore absolutely a bounty. They complain that the British buyer is giving a very high price for the American sugar, and yet, almost in the same breath, they complain that the American refiner is selling his sugar to the foreign buyer cheaper than he sells it to the American public. Of course he does, because he sells to the one at the "short price"—that is, without the duty—and to the other at the duty-paid price.

Mr. BROUSSARD, Senator of Louisiana, in his speech in the Senate on August 16th, puts this quite distinctly. He says: "They have no right to sell to anyone, allies or non-allies, sugar cheaper than they sell it to the American public." This is equivalent to saying that, as far as sugar is concerned, exportation is prohibited.

Directly afterwards, however, the speaker declares that not a cent of the drawback, "not a fraction of a cent ever finds its way into reducing the price of sugar to the foreign purchaser." The unfortunate British buyer, no doubt, is rather in a corner if he has no other other seller than the American refiner, and therefore he probably has to pay a fairly high price for his American granulated, but the fact, if it is a fact, has nothing whatever to do with the drawback question.

There are more absurdities which might be reviewed, but enough has been said on that side of the story. Let us now come to business and deal with the abolition of the bounty in a reasonable way. We know what trouble we had, from 1872 to 1902, first to convince our Government that the drawback system in some of the foreign countries involved a hidden bounty to the refiner, and then to get the foreign governments to remedy the evil, which was destroying freedom of competition on British markets. It took thirty years to get redress for this legitimate grievance, because our Government refused to take the obvious action which would at once have restored free trade in sugar on British markets. The Government of the United States were more businesslike. They restored freedom of competition on American markets, so far as bounties were concerned, by levying a countervailing duty on bounty-fed sugar, a measure which just saved our West Indian sugar producers from ruin, by giving them a market where bounty-fed competition was abolished.

In the course of this bitter fight for free trade in sugar we did not object to drawbacks which merely returned the duty which had been paid, and to which the producer was fairly entitled if he exported sugar on which he had already paid the duty. But we protested against the drawback being in excess of the duty which had been paid, because it at once stimulated over-production and enabled refiners and producers to sell for export even below cost price and yet make a large profit on their total outturn. The only remedy for such a state of things was to abolish drawbacks by making refiners work "in bond," that is without paying duty on the raw material. In order to carry out that scheme it is necessary for the refineries to be under Excise supervision. The sugar which goes into consumption will then pay the duty on leaving the refinery, while the sugar for export, having paid no duty, will receive no drawback but will be conveyed to the ship under Excise supervision, "in bond."

If Mr. Broussard and his friends can satisfy the United States Government that the drawback paid to the refiners contains some hidden bounty—that it is a drawback in excess of the duty paid—then they will have made out a good case for doing what has been done under the terms of the Brussels Convention, namely, the universal adoption of "refining in bond."

It is a curious fact that Mr. Broussard was interrupted with an inquiry which seems to have suggested refining in bond. "Oh no," he replied "the trust has been trying *to get that privilege*, and they asked that, under this Bill, they be permitted to refine sugar under bond. They have no such authority, and they do not do it. They cannot do it."

This is the most remarkable blunder in this catalogue of blunders. The opponents of the drawback, when confronted with the only remedy against excessive drawbacks, namely, total abolition of drawbacks by means of refining in bond, a system now universally in operation throughout nearly the whole of Europe, reject it with scorn. Mr. Broussard, throughout his speech, speaks of the drawback as a "privilege"—of course, he implies a gross and unjust privilege—which in reality is, as we have explained when duty is paid on the raw material, an absolutely necessary arrangement unless exportation is prohibited. Now, when the only remedy for his complaints is suggested, namely, abolition of drawbacks, he again calls it "a privilege," and therefore treats it as quite out of the question.

After this review it is impossible to treat the anti-drawback agitators seriously, but it is necessary to clear the air by exposing the erroneous fallacies which they desire Congress to accept as sound sense. It is a curious ending to the comedy to read the following words in the document addressed to Congress by the American Sugar Refiners on August 21st, 1917:—"Finally, we renew our suggestion that we be permitted to refine in bond in a manner already accorded by law to other manufacturers, smelters, and refiners."

G. M.

The latest news from New York is that the Sugar Administration Committee of Five consists of Mr. G. M. Rolph as Chairman; Sir J. W. Todd and Mr. J. V. Drake as representing the Allied Governments; and Mr. Earl D. Babst, President of the American Sugar Refining Co., and Mr. W. A. Jamison, of Messrs. Arbuckle Brothers, as representing the American refining interests.

Notes on American Sugar Production.

(From our American Correspondent.)

The events of chief importance in the sugar situation here during the past month have been the enactment into law of the Food Control Bill, and the inauguration under its terms of the first steps toward the regulation of prices and the control of the distribution of supplies.

Sugar is not included in the food control law among the products as to which authority to fix prices is conferred. The law, however, grants very broad powers authorizing the licensing of transactions in anything "necessary" whenever the President may deem it desirable. As it is possible, under this licensing clause, to specify the "profit and practice" of any dealer it will be seen that this amounts practically to the control of prices.

As a matter of fact, the sugar industry was one of the very first to receive the attention of Food Administrator Hoover after his appointment to his position. In a series of conferences with representatives of the various branches of the industry Mr. Hoover pointed out the necessities of the situation as they appeared to him, and received assurances of the willingness of the sugar trade to co-operate in any action he might decide upon as necessary in order to conserve the supply of sugar, and to increase the amount available for shipment to our Allies in the war.

The first positive step taken by the Food Administrator affecting sugar was to request the suspension of dealings in sugar futures on the New York Exchange. This request was complied with immediately, and apparently all future transactions are at an end until the termination of the war. While no well-defined explanation for this action has been made public, it was believed apparently that speculative operations on the Exchange tended to increase prices unduly. In his remarks to a Committee of the Exchange who waited upon him Mr. Hoover was careful to explain, however, that he did not hold its members responsible for the recent rapid increase in prices, that in his opinion the Exchange served a highly useful purpose under normal conditions, and that he had advanced his suggestion for the suspension of dealings in futures only because of the extraordinary conditions created by the war.

Another subject that has received attention is the supply of sugar for the army and navy, the estimate of requirements having been put at approximately 100,000 ordinary tons for the ensuing year. At a conference attended by the principal refiners and by representatives of the beet sugar industry, the sugar men agreed to supply the requirements of the Government at a price to be determined by the Food Administrator. The immediate requirements of the armed forces are to be met by the refiners, and after the beet-slicing campaign is under way the beet sugar producers are to take up the task.

Just to-day it is announced that a decision has been reached, as a result of a conference between the principal beet sugar interests and the Food Administration, for the voluntary limitation of wholesale prices as soon as the beet campaign is well under way, which means about October 1st. The basis of wholesale prices agreed upon is 7·25 cents per lb. for fine granulated at Atlantic ports, which means that freight charges from New York will be added in fixing prices at interior ports.

As sugar has been selling of late at from 8·40 to 9 cents, this is an appreciable reduction, but it still leaves prices high enough to be fairly remunerative to producers. The agreement is regarded as highly satisfactory to all parties in interest, as it seems a saving to consumers estimated at approximately $30,000,000 on the basis of prices now prevailing, and still leaves sufficient margin to stimulate further expansion in the domestic production of sugar.

It is expected that this agreement with the beet sugar producers will be followed by others along similar lines with the refiners and the cane producers.

It is anticipated that the price of Porto Rican and other domestic cane sugar of 96° test will be fixed at 5·75 cents a lb., and that the same price will be established for Cuban sugar, duty paid.

Freight charges will be fixed through a special shipping committee on the basis of $5 the ordinary ton from Cuba to New York. This will leave to the refiners for their operations a margin of roughly $1·25 per 100 lbs. If this plan is carried out as expected it will be accepted as reasonable both to producers and refiners, and it undoubtedly can be put into operation without serious friction.

The plans of the Food Administration do not contemplate any attempt at rationing the sugar allowance of the individual consumers or of manufacturers. Consumers are urged to limit their use of sugar as much as they can without serious inconvenience, and it is expected that supplies will be ample for all necessary requirements after October 1st, when the new beet crop sugar begins to come upon the market in quantity.

The success that has attended the plans thus far put forward by the Food Administration for cheapening sugar to the consumer undoubtedly is due in part to the fact that Food Administrator HOOVER has been at pains to consult representative leaders of the sugar industry, and has surrounded himself with practical sugar men in this department. Mr. GEORGE M. ROLPH, General Manager of the California and Hawaiian Sugar Refining Company, at Crockett, California, has been appointed head of the sugar department of the Food Administration, and he has as his assistants men of practical experience in the various branches of the sugar industry.

New York, August 27th, 1917.

Russian Sugar Notes.

The prospects of sugar in Russia during the present and the succeeding campaign are fairly well indicated by a statement just issued in semi-official form showing the probabilities regarding beetroot of the present campaign and what is likely to be made therefrom. It is calculated that the sugar to be at the disposal of the community, including what was brought forward unfinished from the preceding campaign, should make 73,289,385 poods. Adding the stocks of finished sugar carried over, amounting to 7,596,845 p., we get a presumable total quantity of 80,886,230 p. This quantity cannot be called sufficient to meet the needs of the country, because sufficient difficulty had already been encountered in supplying the country's needs with the product of the preceding campaign. There is the inland market and the Army and the Fleet to supply; and if we remember that a small quantity at all events must be reserved for, say, Finland and Persia (in the latter case in order to assist the money exchange balance) it will be obvious that the amount at the disposal of the country this year is all too small.

In anticipation of course of this trouble, steps, as has already been published, were taken to import sugar from abroad, and in consequence thereof the Far Eastern market will not be drawing on the West Russian supplies, but will obtain—presumably again—all its sugar from the outside. Certain reductions have been effected in the quantities of sugar allowed to confectioners and the like; but such economies will not make up for the great deficiency now so obvious. It was expected that at the beginning of the campaign the Bureau of Supplies would have at its disposal about 6,000,000 poods, which would carry it on for a short time until some of the new sugar is ready.

It is found to be more difficult than usual, and this can be understood, to make an estimate of the production of the 1917-18 campaign. It is taken roughly for the purposes of calculation at 60,000,000 to 65,000,000 poods; and on this basis, with the reserves referred to before, the total that can be calculated on for the coming campaign would work out at 68,000,000 or 70,000,000 p. and leave nothing whatever to be carried over into the succeeding campaign, even were there enough to supply current wants. Let it be remembered that previous to the steps taken to control the sugar industry the demand in 1915-16 amounted to 102,929,395 p. Obviously, therefore, the figures previously given show the market is about to be very short of sugar unless a large quantity can be obtained from abroad. This, as is pointed out by the official statement, is very undesirable because the only effect can be to lower still further the exchange value of the rouble. However, even at the cost of such depreciation the sugar will have to be had from abroad.

Quite apart from the ordinary industrial problem that faces the sugar business in Russia there is the financial. In the old days it appeared a simple enough question to obtain the necessary money to run a factory. Advances might be obtained on sugar to be made: or later, they could be obtained on sugar that had been produced, which of course would be pledged against the loans. The situation now is quite different. The Government is controlling the industry, and the producers are no longer free to pledge their product and the Government therefore must do the advancing. This will be possible in something like the same form as before, with the difference that the producers will be still more completely under the control of the financial body from which they obtain their running expenses. The financing will be done, as is understood, not directly through the Government, but by the agency of a combination of banks, which is prepared to put the necessary funds at the disposal of the industry on terms agreed between the Government and the said combination. Shortage of money therefore will hardly interfere with the running of the sugar factories. The product must be had, and the money will have to be provided to enable the owners to turn it out. It may be said in passing that the relations of the Government to the sugar industry are somewhat typical of its relations to other industries which have resulted, of course, through the unsettled political and military situation.

Dealing with questions apart from finance there is not much to be added that has not entered into previous correspondence on the Russian sugar difficulties. The beetroot suffers from short sowings, and also, it is said, from bad weather. But what is dreaded is that, owing to the defective transport, a large proportion of the beetroot will, as in preceding years, be hung up on its way to the factories, and much of it be lost as a consequence, it being left to rot in the station warehouses, if indeed such good fortune could attend it as to get under proper shelter.

The other troubles consist in dear chemicals, dear labour, dear sacking, and so on. In fact, there is nothing in view for the sugar industry but a short production and exceedingly high prices, except in so far as the Government may dictate, *re* the latter, to the contrary. Previous to the Government's intervention the industry, although badly handicapped by the various unfavourable influences referred to could always be looked upon as a generally healthy one, because the enormous prices amply repaid the producer for all the extra cost. But how it will come out from practically direct Government control it is no use trying to predict. It will be curious to observe what the actual product of this year's beetroot will be. Latest estimates are far below what previously had been considered as pessimistic as the authorities dared be. It is to be hoped therefore that even their lowest estimates of a few months ago will prove to be right rather than the latest estimate on the eve of the new campaign.

Petrograd, 3rd September, 1917.

Report on Experiments investigating Weinrich's Dry Lime Process of making White Sugar.

By J. P. OGILVIE.

Experiments were recently carried out in the Guanica Centrale, Porto Rico, for the purpose of investigating Weinrich's dry lime process of making white sugar,[1] it being the intention of the factory at that time to produce this grade. An experimental plant was erected, and although this was far from complete, it was sufficient to produce almost water-white juices, which were considered to be better even than those obtained in beet sugar factories. By this process, it is claimed to attain results in the clarification of raw cane juice that are far superior to those obtained by means of carbonatation; and as moreover the method is both an economical and a simple one, it merits the attention of technologists desirous of turning out a high-class product.

Plant.—The plant consisted of: a lime crusher, a lime mill, an elevator for the powdered lime, a bin with feeding device for the powdered lime, a magma or mixing tank with a sieve, two first carbonatation tanks 12 ft. high by 8 ft. in diam., provided with stirrers; heating coils, etc.; two second carbonatation tanks 10 ft. high and 8 ft. in diam., without stirrers; two filter-press pumps, one twin pump for the carbon dioxide gas, and one gas washer.

No lime-kiln had been erected for this plant, it being intended to utilize experimentally the flue gases from the steam boilers; or, if the carbon dioxide content from these prove too low, to generate the gas in a Otto producer from coke. The first experiments with flue gas showed the carbon dioxide content to be only about 5 per cent., which certainly was too low for any chance of a satisfactory result.

Therefore, the gas washer was connected with the producer, which, however, was rather a small one, being only about 5 ft. high and 3 in. in diam. It was charged first with coke alone, to which later was added some limestone in small pieces. The gas generated in this way had a content between 8 and 17, averaging about 13 per cent.; whereas that from a Belgian lime-kiln as used in beet sugar factories is generally about 30 per cent.

Application to molasses.—At first the process was tried on some first molasses of about 55° purity, The temperature of this product was about 50° C., which was too high for effecting a uniform mixture with the lime powder, which partly formed balls, and in fact acted on the molasses only after it had been thinned with water in the carbonatation tanks. Owing to the thin gas, carbonatation lasted for over one hour. Violent foaming occurred, and in order to obviate this, steam had constantly to be sprayed upon the froth, the temperature of the liquor being thus increased to about 60° C. In this way, and on account of the much prolonged carbonatation, a considerable part of the glucose present was destroyed.

These conditions were adverse to obtaining the best results, for Weinrich's process calls for mixing and carbonatating in the cold state, that is, at a temperature not exceeding 35° C. But in spite of these rather serious disadvantages, and although only about 4 per cent. of the weight of molasses of lime powder was used, the purity of the molasses was raised about 5 points, and filtration through the presses was satisfactory, hard mud cakes being obtained.

---

[1] U. K. Patent, 1576 of 1911, and U. S. Patent 1,084,772, see *I.S.J.*, 1914, 192-193. Compare also *I.S.J.*, 1913, 409; 1914, 141-142. Agents for the process for Great Britain and her Colonies are The Sugar Manufacturers' Supply Co., Ltd, 2, St. Dunstan's Hill, London, E.C. 3, to whom those interested should write.

Application to Juice.—It should be understood, however, that the treatment of first molasses by this process is not a matter of first interest, since its main object is the manufacture of white sugar from raw cane juice, the remelt or the second and third raw sugars (and also, if desired, raw sugar from other plantations) being purified at the same time. This is fully set forth in the patent specifications relating to this lime process,[1] which is claimed to be capable of effecting a gain in purity of about 5 points without destroying any, or hardly any, of the glucose present. Both the special treatment and the subsequent carbonatation should be carried out in the cold, and if this be done results can be obtained that are much superior to anything that has been attained so far with the carbonatation of raw cane juice.

Owing to a misunderstanding, no provision had been made at the Guanica Centrale for mixing previous to liming a certain percentage of the raw juice with some raw sugar to a magma; and the raw juice was thus incorporated with about 1½ per cent. of lime powder in the mixing tank without this addition, being afterwards allowed to flow into the carbonatation tanks, there to be carbonatated with the gas generated from the producer.

As is well known, a rapid carbonatation is quite essential for obtaining the best possible results. In beet sugar factories, in which from 2½ to 4 per cent. of lime on the weight of roots is used, the operation with a 30 per cent. gas generally takes only from eight to fifteen minutes, and the stronger the gas and the purer the solution the less will it foam.

Thus, the three disadvantages under which the experiments were made at Guanica Centrale were: (1) that no remelt raw sugar was previously mixed with part of the raw juice; (2) that carbonatation lasted much too long; and (3) that the temperature of the solutions was far too high, a part of the glucose present being thus destroyed.

Notwithstanding these rather serious variations from the correct procedure, an almost water-white and perfectly clear juice was obtained after the second carbonatation. This was repeated steadily day after day during a period of ten days, the liquor always being almost water-white and better even than that obtained in beet sugar factories. Moreover, the press-cakes were uniformly solid and hard in texture and of low sugar content All the experienced sugar men present agreed that this liquid would make a perfectly satisfactory white sugar; but at the time it was impossible to work it up in separate tanks, evaporators, pans, and centrifugals as far as the final stage of manufacture, so that the liquor had to be allowed to run into receptacles with the ordinary defecated juice being made into raw sugar. But from the juice treated in this way by the Weinrich process a plantation white granulated could easily have been boiled, especially if remelt raw sugar had previously been mixed into the raw juice to receive in this way the same purification.

The filter-press cakes contained 46 per cent. of water, and 4·8 per cent. of total sugar, of which 4·2 per cent. was free and 0·6 per cent. was combined, these figures comparing favourably with normal work in a beet sugar factory. No attempt was made to wash the cakes in the presses, provision not having been made for so doing.

No sulphur in any form was used; and only in a few instances 2 quarts of liquid phosphoric acid to 8 tons of juice were added after the second carbonatation. The average gain in purity was 3·25 points; while 25 per cent. of the glucose had been destroyed. · Occasionally, when carbonatation could be carried out more rapidly and at a lower temperature than mentioned, the gain rose to 7 points, while sometimes the loss in glucose was insignificant. Now according to reports on the results of double carbonatation in the sugar factories in Java, the average gain does not exceed 2 points, while about one-third of the glucose is destroyed. There would appear to be no doubt that when operating this process with a fully-equipped plant, an average gain of at least 5 points could be obtained without destroying any of the glucose.

---

[1] *Loc. cit.*

These experiments were very ably conducted under the supervision of Mr. F. T. MAXWELL, the Superintendent of the Guanica Centrale; by Mr. A. L. MATHEWS, a well-known beet sugar expert; and by Messrs. H. NADLER and C. C. CAPDEVILLE; and thanks are due to all these gentlemen for their efforts. They certainly did everything possible under the rather adverse conditions prevailing.

Ball Bearings in the Sugar Factory.

By FRANK COXON.

The application of ball bearings to the sugar-house, in accordance with examples illustrated in makers' catalogues, has not so far got beyond the centrifugal machine, and a more extensive use or the suggestion of such has very often appeared ludicrous to many.

This is due to causes—some quite hypothetic but of no small importance, a few of which may be enumerated as follows:—

(*a*) The name "ball bearing," due to its previous long run in inefficient application, at once suggests complications for supervision by black labour.

(*b*) The initial cost of this form of bearing, complete with its pedestal, is greater than that of the merchant type brass bushed.

(*c*) Existing journals are not suitable for adaptation.

(*d*) To specify ball or roller bearings when ordering a standard make of machine very often seriously increases the cost due to alterations of patterns.

(*e*) There are no ready means of ascertaining what the makers claim in saving of power consumed, and very little data on how the average life compares with that of the brass bush.

Many of these troubles and obstacles, if not all, can very easily be wiped away upon sympathetic investigation.

(*a*) First and foremost the bearings, or perhaps a better way of explaining it, the ball part, is now made all self-contained, and the old trouble of balls dropping out, so familiar to everyone, has been eliminated for good. This at once removes any idea of complication.

(*b*) Very little is to be gleaned on this point from the manufacturers, and customers are left to work out the relative increase for themselves in conjunction with extra life and advantages from reduction in friction. To many people this may be at once apparent and obvious, but much could be given yet on this point.

(*c*) Existing journals are in most cases quite suitable for the application of ball or roller bearings in place of brass bushes, complete new blocks to suit the existing bolt holes being necessary.

(*d*) There is no doubt that the application of ball bearings to standard products has so far been neglected, except in such cases as worm gears and the like, but this has mainly been due to the feeling described under (*a*), brought about by manufacturers' inability to make a suitable self-contained article.

It is quite the exception now, however, to find a ball bearing other than that of the self-contained type, and for any repairs or alterations, inspection, etc., the whole of the ball arrangement comes out in one piece, the balls still remaining in their seat.

Here again, as regards standard machines, very little information can be found on the advantages to be obtained by the adoption of ball bearings, the increased cost but reduced power to drive being obvious.

(*e*) The manufacturers are loth to deal with the question of power consumption and advantages of conversion in the literature advertising their wares, it being considered quite sufficient to assume that the term ball bearings implies a spin for ever. The complications of conversion, mechanically, may be real however, but much light could be thrown on the subject by the makers.

Figures on various conversion projects carried out and tested would be of interest and convincing to a great degree.

There are many items in the sugar factory which can be conveniently converted at very little extra cost and bring about an improvement in "steam conditions," but the old prejudices have to be eliminated first to appreciate the application.

Broadly, steam is generated in the home factory, and absorbed by countless bearings, hence the careful consideration now given to the subject, and the universal adoption at home of all types of ball or roller bearings.

In the sugar factory steam is generated and used for evaporating purposes, the frictional absorption being of a minor character compared with the work done by the steam as a total.

For all this difference, however, much advantage can be obtained in a more general adoption of anti-friction bearings. How important these small alterations in all directions which affect steam raising are considered will be seen from Hawaiian reports on oil consumption and its reduction, stating: "Without proper lubrication and the right quantity of oil between two rubbing surfaces there will be a friction loss which goes on day by day, and which means an increase in fuel bills. This may not be noticed in some of the sugar factories where they have an ample supply of bagasse; but where bagasse and boiler capacity are barely sufficient, and where fuel oil is used as in many large factories, any unnecessary friction will increase cost of production."

Roller bearings, it should be remembered, whilst being next in order of efficiency to balls, have quite as great an opportunity for adoption, except in the matter of thrust; for rolling stock the application is ideal, both in theory and practice.

To give a schedule of the various machines where ball bearings can be satisfactorily employed in the sugar factory would be difficult, as there are many conditions of working to be considered, not the least of importance being the attention required during the off season of grinding, the balls if allowed to rust become practically ruined for work at the commencement of the next year's campaign.

Whilst the more important machines can have attention and overhauling, it would probably entail considerable labour for an overhauling of the minor ones or bearings; the engineer-in-charge, however, discriminating here according to the particular conditions existing.

Manufacturers could give a much greater interest and impetus to the use of these bearings in tropically-situated factories, if the various prejudices were once overcome by the ventilation of their experiences in a better manner.

The United States Food Administration.

An Official Survey of the Situation.

According to an official pronouncement of the United States Food Administration, a review of the sugar situation shows that it is not actually a lack of sugar that emphasizes the need for its conservation in the United States so much as inability to get the sugar to the places where it is needed. The world's shortage is comparatively small and confined to Europe. With the stocks on hand in this country and Cuba, and those now coming from Hawaii, it would appear that with proper management and with speculation and hoarding eliminated, there need be no scarcity, even in the immediate future while awaiting the new crop.

The world's supply of sugar for the present year is estimated at 18,659,792 tons (16,660,529 long tons), as against an average production of 18,712,997 tons (16,708,011 long tons) for a pre-war period of five years.

While our stocks of raw sugar are at present being rapidly depleted by the assistance we are giving the Allied Nations, that is the usual condition for this time of year. There has been an increased domestic demand which would seemingly indicate the storing of domestic supplies by householders, possibly through fear of a scarcity at this season. In 1916, the amount taken for consumption in the United States from January 1st to June 30th was 2,394,261 tons (2,137,733 long tons), while in the same period of 1917 the amount so absorbed was 2,650,527 tons (2,366,542 long tons), an increase of 256,266 tons (228,809 long tons), or 10·7 per cent. over 1916. If this increase is due to advanced buying it will afford a degree of relief to present demands.

The Cuban crop of 1916-17 has just closed. It was up to normal. It is estimated that Cuba can yet furnish from this crop 687,840 tons (614,143 long tons).

The Hawaiian crop, which closed in July, gave 633,000 tons of sugar. This has been unusually slow in reaching the United States because of scarcity of shipping. About 200,000 tons (178,571 long tons) still remain on the Island.

The Philippines have on hand about 70,000 tons (62,500 long tons), and Java more than 600,000 tons (535,714 long tons). This supply also becomes a problem of shipping.

These four sources of supply, with the domestic stocks on hand, constitute the present sugar resources of the United States.

The harvest of sugar beets in California is now on, and the first sugar from there should begin arriving in the market immediately. Most of the domestic beet crop comes later, largely in October. The crop planted for beet sugar this year is much the largest in our history, and is reported in good condition. The total production, forecasted at 1,000,000 tons (895,000 long tons) as against a five-year pre-war average production of 724,346 tons (646,737 long tons).

The domestic cane sugar crop begins to come in in October. Estimates are for about the same crop as last year, or around 300,000 tons (267,857 long tons) as against a pre-war five-year average of 241,837 tons (215,925 long tons).

The beet sugar producers of the country have entered into an agreement with the Food Administration that they will sell beet sugar on a cane basis of $7·25 per 100 lbs. at seaboard points. Under this agreement after October 1st the price to the wholesale trade at interior points will be $7·25 per 100 lb. sack, plus freight charges from New York, New Orleans, San Francisco, or other seaboard points.

The wholesale grocers who purchased sugar in large quantities with the expectation of receiving materially increased prices are thus given to October 1st to dispose of their holdings.

The lack of adequate shipping facilities to reach the source of sugar supply, and the imperative demand to supply the needs of our Allies, constitute the sugar problem of the United States, and create the necessity for sugar conservation recommended by the Food Administration.

The conservation asked of the American people does not necessarily demand great sacrifices. It only means the elimination of waste and a careful use of sugar to enable America to make up the difference required by the needs of the Allies. The per capita sugar consumption in the United States is 89·14 lbs. per year, while in France it is but 43·85 lbs., and in Italy but 11·68 lbs. England, which alone surpassed the United States in the per capita consumption of sugar, is now upon a conservation basis whereby their per capita consumption is to be reduced from 93·37 lbs. to 26 lbs. per year.[1] No such denial is required of the American people.

A New Method of Weed-killing in Cane Fields.[2]

A Successful Hawaiian Invention.

Within the past year a novel process of destroying weeds in cane fields has been devised and developed by CHARLES F. ECKART, manager of the Olaa Sugar Company, with the result that less than one-half of the labour formerly required is utilized on the treated areas in bringing the cane to maturity. In addition to this large saving in manual labour which is effected by the process, the increased yield of cane which is obtainable as a direct result of the treatment is estimated at not less than 10 tons per acre on an average.

The process is based on the principle discovered by Mr. ECKART that small, unexpanded cane shoots are able to penetrate a suitable paper covering placed directly on the rows of stubble immediately after harvesting, whereas the weeds are unable to penetrate the covering.

The first step in this process is to "palepale" or free the rows of the trash in the ordinary way, as soon after harvesting as possible. During this operation a point is made to cut off, with the hoe, any shoots which are in evidence in the cane row. The ratoon rows are then fertilized, the fertilizer being distributed along the middle of the rows. Strips of tar or asphalt felt (weighing not more than 9 lbs. per 100 sq. ft.) are next superimposed longitudinally on the rows of ratoon so that they lie directly in surface contact with the same in the form of a cover. If the fields contain a fair number of stones or rocks, which are conveniently at hand, these are placed along the edges of the paper strips to hold them down, and in addition thereto the edges of the strips are also covered well with some of the cane trash lying in the adjacent spaces between the cane rows. It has been found that the trash is generally sufficient in itself to hold the papers in place against the tendency of the wind to lift them.

A mechanical device, due to the ingenuity of H. E. STARRATT, is employed for the laying of the papers, and this operation is performed very rapidly and at small expense.

Owing to the spear-like and comparatively rigid nature of the young cane shoots and the mechanical pressure they are able to exert when they come into contact with the paper covering, the latter is punctured and the shoots emerge. The weeds, with their relatively soft terminal points, which spring up under the covering, on the other hand are unable to puncture the paper, and are soon smothered out or in their blanched condition are dried up by the solar heat radiating from the under side of the covering material.

---

[1] It is pointed out correctly enough in New York sugar circles that this comparison is not exactly accurate, inasmuch as the United States figure covers the amount of sugar used for all purposes, while the 26 lbs. in the United Kingdom refers solely to the sugar bought direct for household purposes, and does not include sugar contained in sugared goods The American figure should be about 53 lbs., which makes the American consumption just double what it is in Great Britain.

[2] Reproduced from the *Pacific Commercial Advertiser*, Honolulu.

If the cane rows were smooth and regular so that the paper could lie in perfect surface contact with them a complete stand of cane would emerge through the covering strips. Small irregularities, however, due to stones, elevations of the old stools, or to unevenness of the land, allow many of the young shoots to expand or unfurl before they come into contact with the paper. Since these expanded shoots are neither spear-like nor rigid most of them are unable to puncture the paper and come through, but unlike the weeds they manifest surprising vitality and by continued growth cause tent-like elevations of the paper covering.

After five or six weeks from the application of the paper coverings to the cane rows labourers pass along the rows and with a knife cut longitudinal slits in the paper at such places as are under pressure from expanded shoots, these places being distinctly manifested by the tent-like elevations previously referred to. This slitting is inexpensive and costs about 35 cents an acre in practice. During the interval between the laying of the paper and the slitting operation. the soil under the paper becomes bare of weeds, and furthermore, due to the radiated heat from the dark coloured paper, such weed seeds as would germinate under normal conditions will have sprouted and the resulting young weed plants will have died. On this account no weeds emerge through the slits and those cane shoots which have been imprisoned, as it were, gradually come through and complete the stand in the row. At first these shoots are naturally very white and etiolated, but they quickly turn green and take on a vigorous growth.

The three most essential points in the successful carrying out of the process are as follows:—

The right kind of paper must be used. Of the many papers which Mr. ECKART has tried in his process the best is a light weight tar or asphalt felt. The common black sheathing felt, weighing 9 lbs. per 100 sq. ft. is to be preferred above all others which have been tested. Possibly a lighter felt might prove even more suitable, since the 9-lb. paper is the lightest which has been tried. Too much stress cannot be laid on the futility of attempting to carry out the process satisfactorily with the many paraffin papers and with the heavier grades of building papers.

The paper should be laid on the ratoon rows immediately after the harvesting of the preceding crop and following the necessary clearing of the rows of trash and depositing the latter in the spaces between the rows.

The slitting of the paper covering should not be performed until five or six weeks after the laying of the paper. Long before this time elapses the paper covers become elevated in places from expanded cane shoots which are unable to get through and there is always some temptation to assist them by slitting prematurely. If this is done, weeds will subsequently emerge through these slits along with the cane. The Olaa Sugar Company has found that the rough appearance of the covers due to these elevations is of no consequence.

The large gain in the growth of the cane in this process is due to the automatic eradication of weeds in the cane rows and to the pronounced mulching action of the paper covers. Being black, and impregnated with such material as tar and asphalt, they absorb a large amount of heat which they impart to the soil of the cane rows. There is no doubt but that the elevation of the soil temperature, and the consequent stimulation of nitrification, through the employment of these soil covers is to a very large extent responsible for the vigorous growth of the cane as manifested under the process. The Experiment Station of the Hawaiian Sugar Planters' Association, in testing the heat absorbing qualities of this mulching material, found, according to L. D. LARSEN, "that the soil beneath the paper was from three and one-half to six degrees warmer than the adjoining soil not covered with paper. After 36 hours of no sunshine the soil under the paper was still three and one-half degrees warmer than the surrounding uncovered area."

Such weeds as develop in the "kuakuas," or the spaces between the cane rows, are readily controlled by spraying with a solution of arsenite of soda. If the weather is not suitable for spraying, hoeing is resorted to. Hoeing between the rows is naturally relatively inexpensive as compared with the heavy work of this kind which is required in the cane rows in the ordinary conventional practice.

The Olaa Sugar Company in conducting the process has allowed for two sprayings, and one light cleaning out as representing the average amount of work required under its conditions. A vigorous stand of cane has been laid-by in one instance with no work in the cane row whatever ; in other cases it has been advisable to give one light cleaning out during the crop's growth, so as to remove honohono and other weeds which encroach on the cane rows from the "kuakuas."

The process is now being conducted by the Olaa Sugar Company on a fairly large scale and the directors of the plantation are contemplating the erection of an auxiliary paper mill of sufficient size to meet the demands of the fields for paper mulches. The raw material for the manufacture of the paper will be, in such event, a part of the bagasse from the crushed cane and the mulches will be turned out at comparatively small cost.

This weed destroying and mulching process is covered by patents held by Mr. ECKART.

Royal Commission on the Sugar Supply.

First Interim Report of Operations to December, 1916.

There has just been issued as a Parliamentary Paper [Cd. 8728] the First (Interim) Report with Statement of the Royal Commission on the Sugar Supply, showing their operations from the date of appointment, August, 1914, to the beginning of December, 1916. It is signed by the five (then) Commissioners, of whom Mr. REGINALD MCKENNA, M.P., was the Chairman ;[1] and it is explained in an introductory note that "in view of certain political and administrative changes which have recently taken place, ... and which promise to entail corresponding changes in the constitution of our Commission, both as respects its composition and functions, we have deemed that it would be convenient that we should present . . . . some account of our proceedings up to the present time." In other words, the paper must be taken to be the Report and conclusions of the Commission as carried on under the Asquithian Coalition Government, and is not necessarily the opinion of the Commission as at present constituted. We give below verbatim the section of the Report relating to the purchase of sugar.

PURCHASE OF SUGAR.

Prior to the appointment of the Commission considerable purchases of sugar had been made, immediately after the outbreak of war, under orders issued by the

---

[1] The other Commissioners signing the Report were: Sir H. W. PRIMROSE, Sir ROBERT PARK LYLE, Sir W. CAPEL SLAUGHTER, and Mr. H. FOUNTAIN.

Cabinet Committee on Food Supplies. The contracts for these purchases were taken over by the Commission on its appointment, and subsequent purchases were made in its name. In Table I annexed will be found a statement showing for the periods 1914/1915 and 1916—

(*a*) The total quantities purchased of raw and refined respectively, and the principal countries in which the purchases were made.

(*b*) The average cost of the sugars as delivered in this country (including freight and insurance).

These figures do not, however, represent the total supplies of sugar imported since the outbreak of war. To them must be added:—

(i) Sugars imported by the trade prior to the Proclamation of 26th October, 1914, prohibiting the further importation of sugar.

(ii) Sugars so imported subsequently to the Proclamation, in virtue of the exemption contained in the Proclamation in favour of cargoes cleared from the port of shipment on or before the 26th October, or imported under contract made prior to August 4th, 1914.

(iii) Sugars imported under licence from the Board of Trade, in pursuance of the power conferred by clause 3 of the Proclamation.

To the quantities imported under these several heads, it would be necessary to add the stocks in hand in the United Kingdom, whether in bond or duty paid, at the outbreak of war, in order to arrive at the figures of actual consumption since that date. What those figures may be must remain a matter of conjecture, because no trustworthy records exist of the stocks in the country on 4th August, 1914, or of the importations under heads (i) and (ii) above. The importations under head (iii) could be determined with some approach to accuracy, but are not immediately available. They consist mainly of low class sugars, polarizing below 89°, and used not for refining purposes, but almost exclusively for brewing or for the manufacture of brewing material; and in addition of West Indian crystallized, commonly called "Demeraras." This latter is a special type of sugar, made exclusively for the British market. The total quantity is not large (not more than some 50,000 tons a year), and rather than include it in the sugars dealt in by the Commission, it was found more convenient to leave its importation to be carried on through the usual channels, subject only to the obligation to obtain a licence for each consignment. Later, in the spring of this year [1916], it was found necessary, in view of the effect of scarcity on the prices of such sugars, to take measures to regulate the price at which West Indian sugar should be sold, and arrangements were made whereby a Committee of West Indian brokers undertook to classify such sugar on arrival, and to fix within limits prescribed by the Commission the prices at which it should be sold.

Reviewing the condition of the sugar supply of the United Kingdom during the period under consideration, it may be said that up to end of 1915 the supply was maintained at a figure showing no reduction as compared with normal times, and that there was nothing in the way of scarcity to cause hardship to the public. Such discomfort as there may have been was owing entirely to difficulties of distribution arising out of railway congestion, and the changes in the character of importation, due to the substitution in respect of refined sugar of imports in large cargoes from distant countries for imports in small consignments from near Continental ports. It was not until the early part of 1916 that reduction in supplies, rendered necessary by exigencies of tonnage and of exchange, became appreciable and sufficient to attract public notice. Even so the inconvenience and disturbance of the public mind resulting from the reduction have been greater than the reduction itself would justify if it could have been evenly distributed over the whole community. It would be no serious privation if the domestic consumption of sugar were to be limited to ¾ lb. per head per week of the population. To provide this allowance for the whole civil population of the United Kingdom would not require more than a weekly issue of 14,000 tons. But the weekly issues through the Sugar Commission have during the period of greatest restriction never averaged less than 24,000 tons per week, thus leaving an ample margin for the supply of the naval and military forces and for manufacturing purposes. Obviously, therefore, the problem to be dealt with is one of distribution rather than of quantity. The solution of it is not thereby simplified; on the contrary, it becomes much more difficult and complicated, because regulation of distribution in detail must of necessity demand a highly elaborated system with close supervision of its working, duties which are manifestly far beyond what the Commission could undertake with limited powers and with a small clerical establishment organized with a view to quite other duties, and which for long numbered less than 20 persons in all, and has only recently been increased to 26.

TABLE I.

PURCHASES OF SUGAR.

1914-1915.

RAW.			WHITE.		
Country.	Tons.	Basis 92° nett. Cost c.i.f [1] Shillings per cwt.	Country.	Tons.	Basis 92° nett. Cost c i.f.[1] Shillings per cwt.
Cuba	450,329	19·372	Java	284,997	20·53
Beet	14,632	18·912	Mauritius	316,075	20·37
Java	474,740	17·576	America	243,346	23·29
British W Indian	72,170	18·541	Dutch	28,322	24·03
Domingo, Brazil	5,405	19·142	Cubes	46,153	24·57
Peru and Fiji	16,823	18·833	Various	35,289	20·63
Peru Syrups	2,212	20·989		954,182	
Various, chiefly Peru	78,565	19·07			
	1,114,876				
		1916.			
Cuba	628,635	21·86	America	339,423	27·35
British W. Indies	5,000	19·17	Java	220,062	22·65
Various	53,060	22·14	Mauritius	165,000	24·80
Java	357,711	20·81		724,485	
	1,044,406				

Methods of Purchase.—For the purchase of Mauritius sugar the Commission availed itself of the assistance in 1914 of the Bank of Mauritius and of the Mauritius Commercial Bank in order to arrange the terms on which the whole crop of white sugar should be placed at the disposal of the Commission, the exportation of it having as a preliminary step been prohibited by the Colonial Government. In 1915 and 1916 the Commission worked through the intervention of the local government, the Mauritius banks assisting in the financing of operations. For purchases in neutral markets, principally North America and Java, the Commission has made its purchases from time to time, at moments which study of the markets led it to think favourable. In the American market it has accepted offers tendered through the principal brokers and agents ordinarily dealing in that market, and transactions have been regulated in accordance with the established conditions of the trade. Thus, no brokerage has been payable by the Commission, as the practice in America is for the vendor to pay the broker's charges. For its purchases in Java the Commission availed itself of the proffered services of Messrs. Maclaine, Watson & Co.—the leading firm in Java, through the medium of their London agents, Messrs. Maclaine & Co. Messrs. Maclaine, Watson & Co. made the purchases from planters, merchants, etc., on a "first cost" basis, and transferred the sugar to the Commission on a "free on board" basis at a price exceeding the first cost price by 25 guilder cents per picul. This extra charge was to cover charges of all kinds, storage, fire insurance, interest, Java brokerage, receiving, weighing, sampling, and lighterage. In addition, Messrs. Maclaine, Watson & Co. were paid a commission of 25 cents per picul on the first 300,000 tons, and 20 cents per picul on any quantity over that amount.

---

[1] A fraction of the cost is estimated in cases where the rate of freight has not been finally determined.

NOTE.—The figures in this table are exclusive of purchases made on behalf of Allied Governments.

Prices Paid.—The average cost of the sugars purchased, including freight and insurance, is shown in Table I. But the prices of the several purchases have of course varied with the fluctuations of the market, which directly determined the price paid under each contract in neutral countries. Indirectly, these may be said to have determined also the prices paid in British Colonial markets, as the terms offered by the Commission have always been founded on the prices at which sugars of similar quality were at the time obtainable in other markets. Taking the whole period under review, the Commission is able to say that on this branch of its business it can look back with very solid satisfaction. There have been times, notably at the end of 1914, during which the price of sugar in outside markets has been quoted at rates below those at which the Commission was placing its sugars on the British market. But at those times the quotations have usually been the result of transient influences (including often the Commission's own absence from the market), and have been no true indication of what prices would have been under normal conditions. During the greater portion of the period of the Commission's operations, it is certainly the case that, exclusive of duty, the selling price of sugar in this country has been below that of sugar in New York, notwithstanding the added cost of freight. Thus, at the present moment, eliminating duty, the wholesale price in the United Kingdom of good granulated (the standard quality for refined sugars) is 26s. 10¾d. per cwt. To eliminate duty from the New York quotations for a given quality of sugar is not such a simple matter as it is here, owing to the complexities of the American tariff. The calculation may be made in more ways than one; but, taking it on the basis of duty at the highest rate (and therefore the least favourable to us), the "in bond" price in New York on 1st December of good granulated works out at 28s. 2¾d. per cwt., or 1s. 4d. per cwt. in excess of the price in this country.

Cost of Conveyance.—The freight for conveyance of sugar was engaged in the open market up to February, 1915; from March, 1915, it has been provided by the Admiralty in vessels requisitioned by it for the public service. The rates payable to the Admiralty have varied from time to time according to circumstances, but have been throughout considerably lower than those ruling in the open market, and thus a considerable economy has been effected for the benefit of the public. In addition to the cost of freight the Commission has debited every cargo with a charge for war insurance at the rate of 1 per cent. to 2 per cent. according to circumstances. The total of the marine and war losses is 61,633 tons, of which the value still leaves a balance to the good on the insurance account of approximately £500,000.

Sale and control of delivery.—The sugar imported being of two distinct kinds, raw and refined, separate methods of marketing were rendered necessary. As regards the relative quantities of each it may be said roughly that of the total issues of white sugar since the war, three-fifths have consisted of British refined and two-fifths of imported white sugar.

Sale of raw sugars.—For the disposal of raw sugars arrangements had to be made with the refiners of the United Kingdom. Negotiations with them were accordingly undertaken in August, 1914, by the Cabinet Committee on Food Supplies and resulted in an agreement under which all refineries were to be worked to their maximum capacity and on conditions finally prescribed by the Commission. A scale was laid down on which, according to the net analysis of the raws supplied, they should be debited to the refiners; and a price was fixed at which good granulated should be sold by them to the public, it being understood that variations in the quality of the sugars turned out should be marked by equivalent variations in price, in accordance with the recognised relative market prices of the several qualities of sugar. The margin between the prices of the raw sugars and of the refined output was calculated at a figure which should cover all expenses of handling and manufacture and of duty and should leave a reasonable balance of profit. But, inasmuch as the data for this calculation were uncertain and subject to considerable variation in respect of cost of manufacture, according to the circumstances of the several refineries, a proviso was inserted requiring that refiners should surrender to the Commission any earnings in excess of the amount that would give a profit of 1s. per cwt. on the weight of sugar melted. This method of limiting profits was altered as from 1st July, 1915, and an arrangement was substituted under which profits were limited in accordance with a pre-war standard based on the average profits of each refinery in the three or five years preceding the War. Under both arrangements considerable sums have been paid over to the Commission, and these represent in effect an enhancement of the price paid by the refineries for the raw sugar supplied to them by the Commission.

Sale of imported white sugars.—For the purpose of marketing its imported white sugars, the Commission similarly deemed it desirable to work through the established channels of wholesale distribution, both as providing the most convenient and efficient machinery and as having the further advantage of giving, so far as the circumstances permitted, a continuance of employment to those engaged in the trade as brokers or as wholesale dealers; and arrangements to that end were made with the respective associations of those two classes. In the case of the brokers who act as intermediaries between importers and dealers the interference with their interests resulting from the concentration in the hands of the Commission of the whole business of importation was serious and was difficult to meet. It was obviously impossible for the Commission to undertake to distribute its business equitably between the several firms of brokers; it must necessarily transact its business through a very limited number. To meet this difficulty it was arranged in London by the brokers, on the suggestion of the Commission, that a single firm should undertake the whole business of selling and that the brokerage received for this service (which was fixed at the usual rate of ½ per cent.) should be pooled, and divided rateably amongst the whole body of London brokers, after deduction of a percentage to cover the costs and remuneration of the distributing firm. Somewhat similar arrangements were made with the brokers in Glasgow and Liverpool. The arrangements have worked very satisfactorily.

The distribution of imported white sugars amongst wholesale dealers and large consumers who were direct buyers having thus been provided for, it remained to make with wholesale dealers arrangements regulating the subsequent dealings in the sugar. It was clear that with supplies limited to a single channel, and with no competitive sources open, it would be necessary to guard against the danger of traders utilizing the situation for the purpose of speculation and of the realizing of excessive profits. It would not have been tolerable that after the State had provided adequate, but no more than adequate, supplies of sugar, and had disposed of them at moderate prices, the prices eventually charged to the public should be forced up and excessive profits exacted by the intermediaries through whose hands the supplies reached the final consumer. Accordingly the Commission entered into negotiations with the United Kingdom Wholesale Sugar Dealers Association as representatives of the class, and arranged that no wholesale dealer handling the Commission's sugars should make a larger profit on his transactions than that afforded by the discount of 2½ per cent.[1] allowed by the practice of the trade on wholesale purchases either from British refiners or from brokers. A clause specifically defining this condition was included in all contracts for such sales. The Commission is satisfied that, with all the principal dealers, the condition has been loyally observed. Whether it has always been so by the smaller class of dealers, intermediate between the first purchasers and retailers, is more than doubtful. In certain cases breach of the rate has been proved to the Commission, and in those the offence has been punished by enforcing a return to the purchaser and by suspending for a shorter or longer period, according to the gravity of the case, the supply of sugar to the offender. Where this has been done, suitable arrangements have been made to prevent the clients of the offender from suffering.

Table II. attached shows for the date of first starting of the Commission's operations, and for each subsequent date on which a change was made either in the Commission's prices or in the rate of duty :—

(*a*) The price at which raw sugar, basis 92° net analysis, has been issued to refiners.

(*b*) The rate of duty.

(*c*) The price at which (subject to prescribed discount) good granulated has been on sale by the Commission and by refiners.

The variations in the prices of other sugars, such as Javas, have corresponded closely with the variations in the price of good granulated (which constitutes the standard by which prices are determined in the market) with two exceptions :—

(*a*) From 14th December, 1914, Mauritius crystals were sold to manufacturers using sugar at a reduced rate of 22s. 1½d. per cwt., so that, as prices in this country were at the time higher than their competitors in other countries were paying, our manufacturers should not on that account be put at a disadvantage. When the stock of Mauritius crystals was nearly exhausted (June, 1915) the concession to manufacturers was reduced to an allowance of 1s. per cwt. off the full price of white Javas.

(*b*) From 22nd September, 1915, to 28th October, 1915, the price of cubes was raised to 50s. per cwt. for the purpose of checking the demand for sugar in that form, it being impossible to maintain a supply equal to the demand.

Retail prices.—For the purpose of controlling retail prices, the means possessed by the Commission have been very slight; they may be said to have been limited to advising the public from time to time what the fair retail price of sugar should be, and to remonstrance, and in extreme cases stoppage of supplies, where that price was appreciably exceeded. Apart from the immense number of retailers of sugar, and their wide dispersion, an initial difficulty in the way of precise regulation lies in the fact that no single rate per lb. can be suitable for each and every trader. Allowance must be made for differences of circumstances, for locality, which entails variety in cost of carriage, for class of business whether large or small, constant or intermittent, minute or the reverse in its separate transactions, whether cash and credit, and so on. The view of the Commission has been that all such differences of circumstances, however extreme, should be covered by a difference not exceeding ½d. per lb.; and its practice has been to announce from time to time what it considered a fair minimum price per lb. for good granulated and cubes, leaving that to be taken as the standard by which the relative prices of other sugars should be determined. Up to the end of the first half of 1916 the number of complaints of overcharges, though large, was not unmanageable, and the Commission believes that it succeeded very generally in correcting the overcharges complained of; but latterly, owing to the greater pressure resulting from the reduction in importations, correspondence under this head has increased so enormously that it has been hardly possible to keep pace with it.

---

[1] Since reduced to 1¼ per cent. on account of the increase in the duty.

TABLE II.

Variations in prices of sugar and in duty since August, 1914.

Dates.	Per cwt. (*a*) Raws to refiners basis 92° nett.	Per cwt. (*b*) Duty.	Per cwt. (*c*) "Good granulated"
As from August, 1914	21/10·19	1/10	30/-
,, 26th October, 1914	19/7·422	1/10	27/6
,, 22nd September, 1915	16/11·161	9/4	32/3
,, 24th January, 1916	19/1·929	9/4	34/9
,, 28th February, 1916	20/11·207	9/4	36/9
,, 5th April, 1916	20/11·207	14/-	41/7½

A brief report of the financial side of the work is also given. It may suffice to quote here that "the total disbursements and liabilities incurred (including freight) for sugar bought by the Commission up to the end of November, 1916, have been £81,097,000 in respect of a total quantity of 3,951,349 tons divided into 2,163,082 tons of raws and 1,788,267 tons refined. The total sums realized in cash up to the same date have been £75,263,000. Assuming that stocks in hand and in process of importation are disposed of at current rates, the transactions up to date are estimated to show a profit of about £2,000,000, representing no more than one-eighteenth of a penny per lb. in the sugar supplied."

The Commission state they have all along endeavoured to fix their selling prices with a view to earning returns which should do no more than cover all the expenses of the Commission, and provide an adequate margin against contingencies. But they foreshadow the possibility of a declaration of peace leading to a fall in the price of sugar which would occasion some loss on such stocks as the Commission may then have in hand. In view of this the Commission deem it necessary to provide a substantial margin for meeting this contingency.

According to Lamborn's market report, plans for importing into the United States part of the million tons of sugar now in Java have had to be dropped, owing to the inability to secure tonnage. In any event, it would no longer be possible to get the sugar to its destination in time to be of assistance to the refiners during their slack season.

The American Cane Sugar Industry.[1]

I. Hawaii.

(*Continued from page 424.*)

THE MANUFACTURE OF RAW SUGAR.

Unloading at the Mill.—In Hawaii the methods of loading the cane in the fields and unloading it at the mill are faster than those ruling in Cuba. On most plantations the cane cars are switched into the fields on portable railway tracks and placed conveniently to the piles of cane. The loaders carry the cane in bundles and throw it lengthwise from their shoulders on to the cars, giving little or no attention to further arrangement. In the haul from field to mill as much as 2 per cent. falls from the cars in many cases and has to be picked up later. Systematic and careful piling of the cane when loading is however unnecessary in Hawaii, as at the mill the cane is pulled off the cars by a mechanical unloader which lands it on a slow-moving carrier to transport it to the crusher.

Mill Routine.—The Hawaiian mill is in operation continuously during the 24 hours of day and night, each employee working 12 hours but commonly dividing the work into shifts. In Hawaii, unlike Cuba, the mills only work six days a week, closing down on Sunday. Every mill has an extensive laboratory where chemists and their skilled assistants are constantly engaged in sampling and analysing cane, raw juices, syrup, sugar and molasses. Samples are taken of the cane before it is unloaded at the mill and are analysed at the laboratory. A second analysis of the juice and fibre is made after the cane is passed through the crushers. The usual range of analyses—waste waters, filter-press cake, bagasse, limestone, acids, oils, etc.—is regularly undertaken.

Extraction of the Juice.—In Hawaii preparatory rolls or crushers are the rule. The mills proper consist of anything from 9 to 18 rolls fitted with either spiral spring or hydraulic regulators. Some mills, to save power, have cane cutters fitted, which cut the cane into pieces 4 in. long and then slice it. Others fit shredders which shred the cane to fibre previous to crushing. A good example is the Searby system, which is a combination of shredding, milling and diffusion, and enables a higher extraction to be obtained. Then there is the Messchaert system of juice grooves on mill rolls, which effects a saving of from 1 to 3 per cent. of the sugar in the cane. This last method, first applied in the grinding season of 1914, was in use in October, 1915, in 30 of the 45 factories in operation, 116 rollers being grooved in this manner. In new equipments since ordered these shredding and grooving systems were a feature of the installation contracts.

From the crusher the matted cane passes through the first set of rolls and the juice extracted is screened and run to the juice tank. The cane then passes through the remaining elements of the mill, being subjected to hot maceration between each set of rolls. In the best designed mills, handling cane containing not over 12 per cent. of fibre, the extraction of sugar is over 97 per cent. The bagasse, comparatively dry as it leaves the last rolls, is conveyed to the boiler house on a wide slat conveyor and fed directly into the furnaces.

The best milling results in the 1913-14 season were at a factory where the following figures were recorded : Sucrose per 100 per cent. of cane, 13·32 ; sucrose per 100 per cent. of sucrose in cane, 97·68; sucrose in cane, 13·64; purity of first juice, 85·53.

---

[1] Abstracted from "The Cane Sugar Industry" an inquiry into the agricultural, manufacturing, and marketing costs in Hawaii, Porto Rico, Louisiana, and Cuba, by the United States Bureau of Foreign and Domestic Commerce. Miscellaneous Series, No. 53, Departmen of Commerce, Washington. (See *I.S.J.*, 1917, 359).

Clarification of the Juice.—The juice is as a rule pumped from the juice tank to the top floor of the factory, and after being limed is heated to temperatures varying from 212° F. to 235° F., differing with the system or method used. The hot juice is then run into large settling tanks whence the clear liquor is drawn off and filtered. The filters consist of cylindrical iron tanks packed tightly with ordinary wood fibre known as *excelsior;* other filtering substances are sand and bagasse. The scum and mud remaining in the settling tanks are diluted with hot water, limed again and stirred, after which the contents are washed out into the filter-presses, where the mud and other impurities are separated and the filtrate sent to the evaporators. In general the presses are of the horizontal type fitted with filter cloths.

The Deming method of clarification by defecation is in common use. The apparatus consists of three horizontal iron cylinders in which tubes 2 in. in diam. are fixed; these tubes are connected with each other by chambers at front and back in such a way that the juice pumped through them flows to and fro with great velocity. Thence the hot juice is conveyed to settling tanks.

Concentration of Juice to Syrup.—The concentration of juice to syrup is most commonly accomplished in a quadruple effect, though sextuples are not rare, and there is at least one quintuple. There are various types of effects in use. Some are cylindrical, others square; while both horizontal and vertical apparatus are found. Nine factories possess large quadruples of the "Standard" type, these being considered to give the best results.

The largest quadruple installation found in Hawaii has a heating surface of 22,900 sq. ft. and can evaporate 194,000 lbs. of water per hour. The average for 21 factories is about 11,000 sq. ft. and 74,500 lbs. of water per hour.

Curing.—Curing is usually effected in 40 in. centrifugals, driven most commonly by belt power. After the purging, the sugar is dropped into bins whence it is drawn off through spouts into sacks holding approximately 125 lbs. each. Many of the factories use automatic bagging, weighing, and sewing machines. Others fill the bags and truck them to a scale where the required weight is adjusted with a hand scoop.

Each bag of sugar is marked to indicate the plantation it came from and its destination. The net weight of the sugar in each bag is recorded, while a sample of sugar is taken and its sucrose content ascertained.

White sugar manufacture, wherein the sugar is washed in the centrifugals, has not come into general use in Hawaiian sugar factories.

Fuel.—Fifteen of the 37 Hawaiian sugar factories grinding during the 1913-14 season had no expense for factory fuel, the bagasse being the only material employed. The other 22 factories had to supplement the use of bagasse with fuel oil, and incurred an expense thereby which worked out at $1·78 per acre, or 30 cents per ton of sugar.

The importance of bagasse as fuel for supplying the factories with steam is very great. In Cuba there was, during the season under review, only one important large factory that generated all its steam from bagasse; all the others supplemented their bagasse with wood or coal; but all factories effect a great saving through its use.

In Hawaii a large number of the mills also burn molasses as a supplementary fuel, and as over 75 per cent. of the molasses is normally thrown away its use as fuel has not been attended by any increase in cost. Two methods of burning this refuse are employed; in one the molasses is mixed with the bagasse and thereby binds the finer particles of the latter together so that they are no longer liable to be carried along by the draught in the grates and so lost up the stack or otherwise. Everything is burnt to a slag, which requires removal once a fortnight only, but the tubes keep cleaner than they did when bagasse alone was burnt. The rear of the boilers has however to be cleaned every six hours by a blast of steam.

The second method of burning molasses is to spray it into the furnace with steam in a manner similar to that employed when using fuel oil. Its application is described by the manager of a large mill as follows:—

> "We have burned as much as 660,000 lbs. in 144 hours, with a single day's maximum of 160,000 lbs. This was burned in five furnaces, giving an average of 16 tons or 2,560 gallons per furnace per 24 hours. Tests have shown that 1 lb of molasses equals 1 lb. of bagasse, which gives molasses a fuel value (as compared to oil at $1·37 per barrel) of about 30 cents. per barrel of 42 gallons. This value does not include the value of the ash obtained by the use of molasses as fuel. About 2 per cent. of the water evaporated in the boiler is used to atomize the molasses. Molasses is atomized, the jet pointing to the bridge wall of the furnace. This entirely eliminates the possibility of the formation of clinker upon the grates Every six hours the tubes are blown free of deposit—the products of the combustion of the molasses. Molasses pressure maintained by the pump is about 30 to 40 lbs., and steam pressure used to atomize the molasses about 25 lbs. Two burners are used per furnace The burners proper are lengths of 1¼ in. pipe projecting 18 ins. into the furnace, from the front, with the mouth flattened down to a horizontal opening of ⅛ in. Projecting half way into this pipe is a piece of ⅜ in. pipe connected with the steam line. This steam not only atomizes the molasses but heats it before it is burned. Care should be taken when shutting down a burner to keep the steam blowing through for a few minutes in order to drive out the molasses in the burner and prevent clogging"

II. Porto Rico.

GENERAL.

Porto Rico is the most eastern and the smallest of the Greater Antilles and is well within the tropics, occupying a position about midway in the chain of islands connecting Florida and Venezuela. It is approximately 1500 miles from New York, 972 miles from Key West, and about 500 miles north of Venezuela. The island is rectangular in shape, being 100 miles long and 36 miles wide, while the area is 3349 square miles or about three-quarters the size of Jamaica.

There are three main physiographic regions of Porto Rico: It is traversed from east to west by a range of hills and volcanic mountains, with a maximum altitude slightly over 3600 ft. and sloping toward the coast, gradually on the north and abruptly on the south. Surrounding this mountainous region is an elevated area of coral limestone. The third division is a coastal plain of varying width, which extends back from the coast line to the hills.

The climate is an equable one, thanks to the North Atlantic trade winds, the temperature throughout the year being nearly uniform. The average annual temperature for ten years past has been about 76°F., falling to 73° in winter and rising to 79° in summer. The rainfall is variable; in certain regions it is abundant, while in other areas it is scanty. The average annual precipitation in districts on the north side exceeds 135 inches; on the south coast the figure is about 45 inches, with a minimum (in 1907) of 21 inches.

Owing to more or less variation in agricultural and climatic conditions, the island is divided into five cane producing districts—the northern, the southern, the eastern, the western, and the interior. In the northern district the planter is confronted with too much water, as the rainfall is excessive; this water has to be carried off by surface drains and tile pipes. In the southern district the reverse obtains, as here several months may elapse with little or no rain. Owing to this scanty supply and uneven distribution, extensive irrigation has to be resorted to if cane is to be grown. Since the United States occupation of the island, the Government have installed an extensive irrigation system on this side of the island, which has been very successful, enabling the planters to increase their production per acre, and rendering available for agricultural purposes large sections which were formerly useless on account of lack of water.

The eastern district has a fair amount of rainfall and is partly irrigated. The western one, like the northern, enjoys an abundant rainfall, and there drainage is also necessary. The interior district is in the centre of the island, and the cane is here grown on the hillsides and in the valleys. Though this district is well watered, the yield per acre is smaller than in other sections, owing to the nature of the soil.

The greater part of Porto Rico consists of a series of mountain chains composed of large igneous and volcanic rocks; surrounding this is an area of coral limestone; while the coastal plain consists of alluvial lands and soils of a sandy texture. The four principal soils in order of preference for sugar cane are the Ponce (in the south) loam (irrigated), the Aricibo (in the north) silt loam (unirrigated), the Ponce sandy loam (unirrigated); and the red clay or *adjunctas* soil. This last is found over a large part of the interior of the island.

The area of Porto Rico under cane in 1916 was estimated at 203,491 acres, being 40·40 per cent. of cultivated land, and 9·95 per cent. of the total land. Coffee comes next with 167,137 acres. The population in 1910 was 1,118,012, of whom 722,791 were native whites, 9764 foreign-born whites, and 385,437 blacks and mulattos. Nearly 88,000 are employed in the cane sugar industry. Sugar exports are now about 50 per cent. of the total.

Development of the sugar industry.—Sugar cane was brought to Porto Rico from Santo Domingo in 1515, and in 1530 the industry made a real start with three sugar plantations which manufactured molasses only. In 1548 one Gregorio de Santa Olaya established a mill near the Bayamon river operated by water and horse-power, and produced the first sugar manufactured in Porto Rico. By 1602 there were eight mills on the island, producing 75,000 lbs. of sugar.

Before the American occupation in 1899 the methods used in the manufacture of sugar were still very primitive. The cane was crushed in small mills, the machinery consisting principally of single and double wooden rollers driven by bullocks, open kettles for boiling, wooden vats for crystallizing out the second sugar, and dripping rooms where the hogsheads of crude sugar were drained of their surplus molasses. Since the Americans entered into possession, new and improved machinery has been installed, railroads built to transport the cane, and improved methods of cultivation introduced. This process of renovation was greatly expedited by a hurricane in 1899, which devastated the island and destroyed many of the old sugar factories. And centralization has since been the order of the day, one large American central now superseding the work of 31 older mills.

Besides the irrigation system, the Government of Porto Rico have seen fit to establish an agricultural experiment station to assist the island agriculture. This is situated at Rio Pedras, near Mayaguez, and is conducted under the supervision of the United States Department of Agriculture. It has proved of great value to the sugar planters of the island, and has had much to do with the improved methods of cultivation now employed. Circulars and bulletins in both English and Spanish deal with the proper cultivation of cane, the treatment of soils, proper fertilizing, eradication of insect pests, breeding of live stock, etc. Besides the station, there has been created under an Act passed in 1911 a Board of Commissioners of Agriculture, whose duty is to gather and publish information and statistics relative to agriculture.

THE PRODUCTION OF SUGAR CANE.

For the 1913-14 sugar crop, investigations covering 72 per cent. of the sugar turned out in Porto Rico showed that 62·64 per cent. of the cane was grown by cane farmers (or colonos), while 37·36 per cent. was grown by the sugar companies themselves. There are several classes of colonos: some produce cane on their own land, and finance cultivation expenses themselves; some produce cane on their own land, but are financed by the centrals to whom they sell their cane; others rent land and either finance their crops or are financed by the central; finally, there are farmers to whom land is furnished by the central either free of charge or at a nominal rental. Some of the colonos who cultivate central land own their farming implements and animals, but more frequently the central furnishes the seed, fertilizer, agricultural implements, etc., the colono furnishing only the labour.

The acreage grown by the colonos varies from one to 20 acres, the average per colono being 4·43 acres. Centrals usually contract with them to plant a certain number of acres in cane for a term of years, payments being made either in cash or sugar. In nearly all instances the cane is transported from the fields to the factory at the expense of the central. The latter tries invariably to make the contracts to cover as long a term as possible, usually from five to ten years, in order to ensure a uniform supply of cane. Large amounts of money bearing interest are loaned to the colonos to assist them in financing their crops. In the year investigated the average price paid to all colonos for the cane was $3.89 per ton, while the average cost of estate cane was $3.92 per ton. This cost of colonos' cane is nearly twice that paid in Cuba, the difference being explained by the condition of the soils in Porto Rico and the methods used in cultivation.

These methods were pointed out in a report made by Mr. J. T. CRAWLEY of the experiment station in 1911, and had changed but little up to the time of the 1914 crop, though some of the larger plantations have inaugurated greatly improved systems since then. The principal observations and commendations in this report were as follows:—

(1) Most of the cane soils are sedimentary, and while of great original fertility, many of them have become exhausted by long cropping.

(2) For fall planting the land is usually well prepared, but is often improperly prepared for spring planting.

(3) Ploughing is too shallow; deeper ploughing would improve both deep and thin soils.

(4) Furrow system should be introduced in hill lands, sandy and well-drained soils, followed by mechanical cultivation.

(5) Cultivation is inadequate and expensive, owing to the system of planting in holes.

(6) The white cane is too weak for most Porto Rico fields and conditions, and efforts should be made toward finding more suitable canes.

(7) Insoluble fertilizers should be applied to the furrow before planting, and all fertilizers should be well distributed in the rows or around the stools of cane.

(8) The moth borer and root diseases are widely spread and are doing much damage.

(9) More attention should be given to the selection of seed and the destruction of seeds that are borer-invested or suffering from root disease.

(10) The manufacture of sugar in Porto Rico has advanced more rapidly than the production of cane. Immediate efforts should be directed to the fields.

Other conditions contributing to the high cost of cane in Porto Rico as compared with Cuba are: (1) Drainage, which is a large item in agricultural expense; whenever land is planted drains have to be cut, and they must be kept clean through the year. As in most instances the land is planted each year, and where the crop is ratooned it is only for a period of two or three years, the work of ditching is a constant expense. A considerable amount of cane land is drained by tile drains placed beneath the surface; although the first cost is high these continue in operation for a considerable length of time and they eliminate the waste of land occasioned by surface drains. (2) Irrigation, which is the rule on the south side of Porto Rico and is likewise an important item of expense, the cost of watering from privately-owned plants varying from $25 to $50 per acre, while the rates charged by the Government irrigation works vary from $2.50 to $3 per acre-foot, according to the distance of delivery. (3) Fertilization. Porto Rico is an old agricultural country and much of the land has been cultivated for the past 300 or 400 years. This continuous cropping has greatly decreased the productiveness of the soil, for in former years the policy was to get as much as possible out of the land without putting anything back into it. No fertilizers were used, and methods of cultivation were crude and destructive. As a result the once wonderfully rich soil is very much depleted, and now fertilizers have to be freely applied.

THE MANUFACTURE OF RAW SUGAR.

For a number of years prior to the acquisition of Porto Rico by the United States in 1899 the production of cane sugar in the island had seldom reached a total of 75,000 tons. In 1901 it rose to 81,536 tons and since then there has been a steady increase in production, culminating in 1916 in 483,097 tons.[1]

During the grinding season of 1915-16 there was a total of 64 factories producing sugar. Nineteen of these produced less than 100 tons of sugar each, six of them having no more than 10 tons each and should not be classed as factories proper. Two factories had over 100 tons but less than 500 to their credit, while 43 factories produced each over 500 tons.

The southern or irrigated districts gave the best results in most respects. Their yield of cane per acre was highest and they required the least cane to make a ton of sugar. Their cost of cane per ton of sugar was lower than that of the northern, eastern or western districts by from $2 to $8 per ton of sugar. That of the interior was lowest of all.

As regards machinery equipment, nineteen factories in 1914 had cane unloaders; there were fifteen 9-roller mills, nine 12-roller and one 15-roller mills, some of them fitted with cane crushers. Quadruple effects were more prevalent than triples. The average per mill of vacuum pans was 3, of crystallizers 15, of centrifugals 17, of boilers 8, while the horse-power of the mills varied from 1200 to over 9000.

MR. ALEXANDER ASHBY, a sugar estate proprietor of Barbados who died recently, has bequeathed his two sugar plantations to the Secretary of State for War, doubtless as some contribution towards the cost of the war. The sale of these properties is expected to fetch between £40,000 and £50,000.

---

[1] The 1916-17 crop just completed is officially announced to have attained to 502,398 tons.

Obituary.

The late J. J. EASTICK.

The sugar industry will learn with regret of the death of Mr. J. J. EASTICK, one of its best-known and esteemed technologists. He passed away somewhat unexpectedly on September 7th, though he had been for some time in indifferent health.

JOHN JOSEPH EASTICK was born on February 6th, 1855, at Great Yarmouth, his father being manager of the Southtown gasworks there and afterwards at Peel, Isle of Man. When the family went to Lancashire he took up the study of science and gained an exhibition at Owens College. He subsequently obtained a Royal Exhibition at the Royal School of Mines, and threw himself with ardour into the various science subjects taught there, finally obtaining the Associateship of the School. His bent was always towards the technical utilization of scientific results, and he found considerable scope for his abilities as first chemist at the sugar refinery of Messrs. ABRAM LYLE & SONS, where he initiated their special methods of making brewers' saccharum, invert sugar, and golden syrup. From 1890 to 1894 he was manager of the Australasian Sugar Refining Co., Melbourne, succeeding in that capacity the late THOMAS R. OGILVIE, of Greenock, and acted as Honorary Adviser to the Victorian Government on beet cultivation and sugar manufacture. Leaving Melbourne for Bundaberg he spent a year in improving and re-arranging Messrs. CRAN & TOOTH's juice mills.

During the next ten years he converted the Millaquin and Yengari juice mills into juice and raw sugar refineries (carbonatation process), was general manager for the Queensland National Bank of their refineries, three raw sugar mills, several juice mills and plantations. He was also director and chairman of the Bundaberg Distillery for many years. In 1906 he inspected tropical and sub-tropical agriculture in the East, but, his health failing, he returned to England and has since then been consulting sugar expert and chemical engineer, in addition to which, at the death of his father-in-law, Mr. B. E. R. NEWLANDS, he took over the analytical and consulting practice of NEWLANDS BROTHERS, at No. 2, St. Dunstan's Hill, E.C. He took out numerous patents connected with sugar manufacture and refining, and published several papers on these subjects. He was responsible for the English edition of Bühler's "Filters and Filter-Presses," contributing also to this work a valuable section on the practical side of the filtration of sugar liquors. He was a Fellow of the Institute of Chemistry, and of the Chemical Society, and a member of the Society of Chemical Industry and of the Society of Public Analysts.

He leaves a widow, four daughters, and three sons, the latter of whom are carrying on the traditions of their father in applied chemistry. Tribute will always be paid to his memory by his many pupils, co-workers, and employees and all who were acquainted with him and were indebted to him for his never-failing kindly advice and aid.

L. J. de W.

Statistics indicate that the amount of food consumed within the United Kingdom during the year 1916 was greater than in any previous one. Doubtless this is mainly due to the fact with the large employment of labour of both sexes in war work the national appetite has been developed to an unprecedented degree. Working at high pressure must bring in its train a wear and tear of the body which cries for increased nourishment. But it is also the case that the plentifulness of money in the pockets of the working classes has tempted them to spend freely on food and other things to a degree that would have been unheard of before the war.

Correspondence.

IMPURITIES IN RAW SUGAR.

TO THE EDITOR, "THE INTERNATIONAL SUGAR JOURNAL."

Sir,—A life-long subscriber to your valued publication and its predecessor, the *Sugar Cane*, my attention was attracted to the editorial in your July number entitled "Impurities in Raw Sugar," in which you say that "it seems highly desirable that the explanation of the Cuban manufacturers should be forthcoming, if Cuban sugar is not to acquire a bad name amongst British consumers."

Permit me to reply, both as a manufacturer of raw sugar of many years' experience in Cuba, and as a refiner of sugar in the United States Cuban raw sugar is not intended, nor is it fit, for direct consumption. Until the outbreak of the present European war the United States was practically the only market for Cuban sugar, due to the fact that Great Britain could obtain its supply at cheaper cost and lower freights from Germany and other nearby countries in the form of refined beet sugar; and also to the preferential tariff rates accorded to Cuban sugars in the United States after the Spanish-American war, against which other cane producing countries, subject to full duties and much higher freight rates, could not to any extent compete

The American consumer will use only the best grade of refined sugar, even the clarified sugar of Louisiana being neglected except in a limited local market Even when the last Tariff Act removed all protection upon refined sugar, putting it upon the same basis as raws, it did not increase its importation or induce the manufacture of sugar in Cuba suitable for direct consumption, in competition with the large refineries of the United States, where skilled labour and all supplies were obtainable at a lower cost.

Hawaii and Porto Rico, both American possessions, have found it more profitable to make raw, rather than refined, sugar up to the present time, for this reason.

Having the refiners of the United States as his only customers, the Cuban manufacturer has made his sugar to meet their requirements, and has found a ready market in cargo lots. These sugars are sold upon their polarization only, regardless of colour, and are not intended for consumption, it being the business of the refiner to remove all impurities in the refining process. This he has been able to do cheaper than the manufacturer can.

As the grinding season in Cuba does not average over five months, the estates have to work night and day; quantity of output, as far as consistent with efficient work, being the first consideration. A sugar of about 96 test is generally made because the adjustments in settlements, of $\frac{1}{32}$ cent per degree up and $\frac{1}{16}$ cent down, in the United States (1½d. and 3d. in England), make that grade the more profitable, as the manufacturer is not compensated for a higher grade.

Unlike the British refineries, those of the United States have a capacity far in excess of domestic requirements They do not wish a high grade of raw sugar, as these tend to further increase their surplus capacity. Moreover, the low grades of Cuban sugar contain a greater percentage of glucose (molasses), needed to a certain extent in the manufacture of so-called soft sugar, for which English Island Muscovado, Brazilian, and Cuban molasses sugar were formerly used, but are no longer available.

For these reasons the Cuban sugars are made to meet the special requirements of refiners, and those bought by the Royal Commission are supposed to be for the same refining purposes; they are not made for direct consumption.

Cuban sugars can undoubtedly be made to fill the requirements of the British consumer, but these cannot be sold upon the basis of raw sugar, and to make a suitable quality will require radical changes from the present methods of the Cuban manufacturer, both reducing the factory capacity and increasing expenses. Once assured of a constant market at remunerative prices, such sugar will be made. Will England take it under normal conditions, or will she find that American granulated, refined from Cuban raws, is intrinsically the cheaper article, as long as it can be bought less drawback, which is a return of Government duties upon the raw material imported? The future cannot be judged by present war conditions.

Yours very truly,

Boston, September 7th, 1917. EDWIN F. ATKINS.

Publications Received.[1]

***Chemists' Pocket-Book: A useful Manual for Chemists, Manufacturers, Metallurgists, Mining Engineers, Assayers and Prospectors.** (International Correspondence Schools, Ltd., Kingsway, London.) Price: 5s. nett.

This little book has been compiled more particularly for the use of the student, but notwithstanding this, in view of the excellent arrangement of the matter, the wideness of the information, and the clearness and accuracy with which details are presented, it doubtless will find favour also with the practitioner, be he engaged in chemical manufacture, metallurgy, assaying, prospecting, or other work. It differs from other chemical pocket-books, the publication of which we have recently noticed, in that it is rather a compendium of standard methods of qualitative and quantitative analysis, blow-piping, and assaying, than almost entirely a collection of general physical and chemical data and tables, although a collection of the most useful of these is included. Some select methods of qualitative analysis, wet and dry, and the analysis of water for boiler and other purposes, and that of flue gases, are described. A section on chemical calculations is given for the use of the student; while the hints on glass-blowing, soldering, and the care of platinum ware is a useful addition that should be welcomed.

***Liste Générale des Fabriques de Sucre, Raffineries, et Distilleries de France, etc. Campaign 1914-15, with Supplement for 1915-16, 1916-17, and 1917-18.** (Paris, *Bureaux de Journal des Fabricants de Sucre*, 160, Boulevarde Magenta.) Post free, frs. 5 25.

This standard annual of the French beet sugar industry, which also includes a list of sugar establishments in Germany, Belgium, Holland, Great Britain, the United States and various colonies, is issued this autumn in the form of the 1914-15 edition—that is the last one before the war—with a supplement giving more recent history and statistics. This supplement is considered preferable by the editor to the difficult task of rearranging the main part of the volume during the war. It contains the rather attenuated list of the French sugar factories which have escaped the effects of the German invasion and have been able to work since 1914 to now. Details are given of the principal legislative and tariff changes effected during the war in France, the United Kingdom, the United States, and in fact in practically all the principal sugar countries of the world. In this respect the Liste Générale should serve a most useful purpose as a work of reference, apart from the value of its actual lists of sugar establishments in the various countries.

The refining industry of Japan is now a well-established one, there being eight large refineries with a capacity of over 1300 tons of sugar per day. Formosa, from which most of the raw product is derived, has now 14 sugar companies in operation, with 37 factories between them, the aggregate output being over 27,000 tons of sugar per day, while the yearly output is already in excess of six million piculs (357,000 tons) of centrifugal and 700,000 piculs (41,660 tons) of brown sugar.

---

[1] Books and other Publications marked with an asterisk (*) can be ordered if desired through NORMAN RODGER, 2, St Dunstan's Hill, London, E.C 3, but in that event the order should be placed with him direct and not through a bookseller Those not so indicated should preferably be ordered from the source of publication, especially pamphlets to which no price is attached, as these are in many instances gratis. Postage as a rule is extra.

Consular Report.

JAVA.

The British Vice-Consul at Sourabaya (Mr. H. H. G. JACKSON) reports that the production of sugar in the island of Java in 1916 amounted to 26,408,100 piculs,[1] as compared with 21,178,700 piculs in 1915, and 22,655,274 piculs in 1914.

It is estimated that the area under cultivation this year will be slightly larger than in 1916. Prospects for 1917 are favourable; the coming crop looks well, and, given favourable weather conditions, should be fully equal to that of last year.

During 1916 trials were made with electrical ploughing machines imported specially from the United States, but, as labour was more plentiful than in 1915, only lukewarm interest was displayed by planters in these experiments.

Exports of sugar from Java from 1st April to 31st December, 1916, amounted to 1,234,200 tons, as compared with 1,152,300 tons and 1,018,200 tons during the corresponding periods in 1914 and 1915 respectively. The principal shipments during 1916 were made to the United Kingdom (537,800 tons), British India (314,100 tons), Hong Kong (104,600 tons), and France (64,700 tons).

It is estimated that at the end of 1916 about 2,000,000 piculs of sugar, stored in Java, remained still for disposal. Owing to the difficulties experienced in shipping other Javan produce there is a strong demand for storage room, and, if shipments are not effected on a larger scale before the new crop comes in, the problem of storing the sugar will not be an easy one.

Review of Current Technical Literature.[2]

MILL WORK AT GUNTHORPES FACTORY, ANTIGUA, B.W.I. *Sir Francis Watts. W. I. Bulletin, 1917, 16, 95-103.*

An interesting collection of milling data is provided by the completion of the twelfth season of Gunthorpes Factory, Antigua, and from these may be gathered the average composition of the canes crushed, and the efficiency of the factory in handling them. Seeing that they have reference to a factory in successive stages of development, they afford information as to the efficiency of different forms of equipment, and demonstrate the comparative value of the additions and improvements that have been made.

Composition of Cane Crushed, per cent.

Year	Fibre.	Sucrose	Year.	Fibre	Sucrose
1905	15·1	15·3	1911	15·8	14·1
1906	15·2	14·1	1912	17·5	14·2
1907	15·1	14·4	1913	17·7	12·9
1908	15·2	14·3	1914	16·6	13·5
1909	15·6	14·2	1915	16·9	12·0
1910	15·9	14·7	1916	16·2	12·5

It is seen that the fibre in the cane is unusually large, and in later years has shown a tendency to increase. This at first was thought to be due to dry seasons, which explanation, however, does not appear to hold good, seeing that in 1915 and 1916 the fibre content was high, though in those years there was a good rainfall.

---

[1] Picul = 136·16 lbs.

[2] This Review is copyright, and no part of it may be reproduced without permission.—(Editor, *I.S.J.*)

Similarly the sucrose values call for comment and investigation. It has steadily fallen off; for, whereas in 1905 it was 15·3 per cent., in the period from 1906 to 1912 it ranged from 14·1 to 14·2, while from 1913 onwards it has only once (in 1914) risen beyond 13 per cent. At present no adequate explanation of this variation is forthcoming, and the matter is one which requires careful consideration. It was thought that the falling off might be accounted for by the undue prolongation of the grinding season; but an examination of the records, while showing that this has some influence, leads to the conclusion that the matter is not fully explained, and that there is a decrease of sucrose content even in the better part of the seasons. It is possible that in dry seasons the sucrose content of the cane increased even more than the fibre content, and that in seasons and places of heavy rainfall the canes contain smaller amounts of sucrose; but even here one is faced with the fact that the years 1909, 1911, 1912, and 1913 were years of trying drought, though of relatively low sucrose in the canes.

Milling and Manufacture Data, per 100 Sucrose in Cane.

Year.	Sucrose in bagasse.	Sucrose in juice (indicated sucrose)	Sucrose in molasses and lost in manufacture.	Sucrose in sugar sold.	Commercial sugar sold per 100 sucrose in cane.	
1905	17·9	82·1	17·4	64·7	67·4	6-roller mill.
1906	20·4	79·6	15·0	64·6	67·5	
1907	15·6	84·4	15·0	69·4	72·2	8-roller mill (Krajewski added).
1908	15·0	85·0	11·3	73·7	76·7	
1909	14·6	85·4	12·9	72·5	75·4	
1910	14·7	85·3	12·1	73·2	76·1	
1911	14·6	85·4	17·8	67·6	70·5	14-roller mill (six more rollers added).
1912	13·8	86·2	15·2	71·0	73·9	
1913	8·9	91·1	13·5	77·6	80·9	
1914	9·4	90·6	12·3	78·3	81·7	
1915	8·7	91·3	8·7	82·6	85·8	
1916	7·8	92·2	7·7	84·5	88·0	

In the first two years, 18 to 20 per cent. of the sucrose in the cane was lost in the bagasse, whereas in the last four seasons this was reduced to less than half. It appears that in 1911 and 1912 the operation of the 14-roller mill had effected no improvement over the work of the 8-roller plant, but these years were ones of drought, little water being available for maceration purposes. In 1913, on the other hand, the mills were more efficiently worked; and, as is seen, the sucrose lost in the bagasse was brought down to less than 9 per cent., being 8·7 and 7·8 per cent. respectively in the last two years for which the data were collected. Considering that the canes dealt with contained some 16 to 17 per cent. of fibre, these last four years reveal creditable work. The importance of the improvement of the milling plant may be demonstrated by pointing out that the difference in the recovery of sucrose from the bagasse between the 8 and the 14-roller mills may be taken as rather over 5 per cent., so that in the Gunthorpes factory with an output of 12,000 tons, the gain, with sugar selling at £13 11s. per ton, would be about £8100. On this same basis the value of the sugar left in the bagasse, even from the 14-roller mill, is approximately worth £13,500 for the factory in question. This seems to indicate that the economical limit of crushing may not yet have been reached.

As to the sucrose unrecovered in the molasses, or lost in manufacture, this has progressively been diminished, being, e.g., 12·3 per cent. in 1914, and 7·7 in 1916. Taking the recovery of the period of 1908-1910 to be about 12 per cent., and comparing it against that of the last two years, which averaged 8·2 per cent., there is a gain of 3·8 per cent., which on the basis of the monetary scale already used represents a gain of £6100. It is important to note that, whereas in the early history of the factory some 65 per cent. only of the sucrose in the canes found its way to market as commercial sugar, in the last year the figure reached 84·5 per cent.: an increase of 19·5 per cent. Had Gunthorpes factory remained in the condition in which it was first erected, there would have been lost last year sugar to the value of £30,370 on a crop of 12,000 tons, at £13 11s. per ton. This does not imply that by the recovery of the additional amount of sugar the whole £30,370 was gain to the factory; only part of this is profit, for there is expense entailed in extra machinery and extra cost in working to ensure the higher recovery; but even allowing for this, there remains a substantial margin of profit.

Consideration of these facts and figures enforces the arguments for the provision of a supply of highly trained skilful chemists and technologists. Ill-equiped factories may fall very short in their recovery of sugar; so that, should a time of low prices and keen competition arrive, as is almost certain to be the case, the owners of such establishments may find their businesses unprofitable.

CARAMELS AND OTHER CONFECTIONERY CONTAINING PARAFFIN WAX. *A. McGill.* *Laboratory of the Inland Revenue Department, Ottawa, Canada. Bulletin No. 365, 1917.*

Attention has previously been called[1] to the presence of paraffin wax as a stiffener in the form of candy sold as chocolates, 7 out of 51 samples, (4·6 per cent.) examined being found to contain this substance, and the following statement was made on the matter: "The National Confectioners' Association of the United States issued a Food Law Circular under date May 20th, 1913, containing a list of substances prohibited in confectionery, among which appears paraffin. The Food Laws of Illinois, Nebraska, and Utah, specifically forbid the use of paraffin in candy; and those of many other States are interpreted in such a way as to condemn its use. It is certain that so-called paraffin or paraffin wax is wholly without food value, is quite indigestible, and is not a normal component of any natural food material. Its melting point (about 54·5°C. = 130·1° Fah.) is so high as to keep it solid at the body temperature, and being quite insoluble in the digestive fluids, it is conceivable that serious results might ensue from its presence in foods consequent upon mechanical disturbances."

In the case of the confection known as Caramels, the use of paraffin is greater, and out of 110 samples examined 51 (46·3 per cent.) were found to contain more than 1 per cent. and 16 of these contained more than 3 per cent. (14·5 per cent.) Whether or not these amounts can actually be regarded as harmful to health is a matter for consideration, and Dr. A. D. BLACKADER, Medical Adviser to the Department, gives it as his opinion that in amount so small as 1 per cent and one might say even 2 per cent., it is not likely to do any harm, but that in larger quantity there is a possible risk in persons or children consuming large amounts of the candy. Ill-refined paraffin may give rise to toxic symptoms. It is of no use as a food, and may be regarded as an adulteration.

CONTROL OF THE SUGAR BEET NEMATODE. *Harry B. Shaw.* *Farmers' Bulletin, 772, United States Department of Agriculture, 1916.*

After many years of experimenting it has been found that the only practicable method of controlling the pest on a large scale is by the rotation of crops not attacked by this nematode. A rotation of four or five years, including beets or other susceptible crops only once in the series, has been found in European countries to keep the pest fairly well under control, but owing to the fact that eggs may be preserved for a number of years in brown cysts, it would be safer to extend the rotation to six years. Where only small areas of land are infested with beet nematodes it is possible to get rid of them by the liberal application of unslaked lime, which should be thoroughly mixed with the infested soil to a depth of at least a foot, the mixture of soil and lime being turned over frequently during the summer. These infested areas generally show themselves about the middle of July through the wilting and yellowing of the leaves. The wilted leaves do not recover during the night.

---

[1] *Laboratory of the Inland Revenue Department, Ottawa, Canada. Bulletin* No. 346, 1916.

All forms of the beet nematode, including the resistant preservation form, the brown cyst, can be destroyed by a short exposure to a dry temperature of 145°F. Beet seed exposed to a dry temperature of 149° to 158°F. for 10 minutes is not injured by the treatment; on the other hand, its power of germination is improved. Should it be established that the beet nematode is introduced with beet seed, this method will be available for the destruction of the pest before the seed is distributed and sown.

Manufacture of Potash from Felspar in England. *Anon. Journal of the Board of Agriculture, 1917, 23, 1087-1091.*

Rhodin's process for converting felspar into a potash fertilizer has been tested by a Sub-Committee of the British Government Fertilizers Committee. The best results were obtained from Roche spar from Cornwall, which contains 10·8 per cent of potash, 76 per cent. of which was yielded in soluble form. A white, or nearly white cement, suitable only for decorative purposes, is obtained by a bye-product, its yield being about 27 times the weight of the potash fertilizer. It is calculated that 100 tons of the Roche spar would yield 82 tons of potash (K_2O), equivalent to 16 tons of 10 per cent. muriate, and about 220 tons of white cement. The adoption of the process on a large scale is recommended.

Climatic Conditions as related to *Cercospora Beticola* V. W. Pool and M. B. McKay. *Journal of Agricultural Research, 1916, 6, 21-66.*

The life of the fungus *Cercospora beticola* wintering in sugar beet top material varies according to the environment. When exposed to outdoor conditions the conidia die in one to four months; but when kept dry they live as long as eight months The sclerotia-like bodies, which are more or less embedded in the tissues of the host, are more resistant than the conidia, living through the winter when slightly protected, for example, in the interior of a pile of sugar beet tops or buried in the ground at a depth of 1 to 5 ins., and become a source of infection for the succeeding crop. Notwithstanding the difference in temperature and soil moisture conditions, similar results were obtained from wintering experiments in other beet cultivating districts of the States.

Thermal tests with artificial cultures showed (*a*) that exposure to constant temperatures of 35° and 36° C. (95° and 97° F.) is fatal to the growth of the fungus; (*b*) that growth occurred when cultures after exposure for three days to either of these temperatures were changed to 30·8° C. (87° F.), and also when they were held at either for eight hours and then at 20° C. (68° F.) for 16 hours; and (*c*) that a temperature of 30·5° C. was fatal in all combinations tested.

Temperature and relative humidity influence the production of conidia and infection in much the same way. A temperature of 80° to 90° F., with a night minimum preferably not below 60°, is most favourable to conidial production, while it is checked by a temperature of 100° F. or more, and is greatly checked by a range from below 50° to 80°. A maximum humidity ranging above 60° for not less than 15 to 18 hours each day induces a good growth of the fungus.

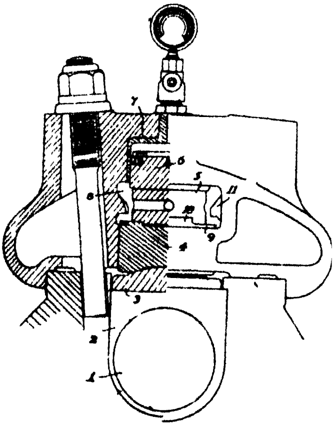
J. P. O.

Review of Recent Patents.[1]

UNITED KINGDOM.

KEY FOR LOCKING FLOATING BUSHES ON MILL ROLLERS. *James Miller and George Fletcher & Co., Ltd.,* of Litchurch, Derby. *101,693* (*11,076* of 1916). Applied for, August 5th, 1916. Accepted, October 12th, 1916.

In certain cases it is desirable to provide means whereby the mill can be kept running whilst repairs or renewals are being undertaken to the parts of the hydraulic cylinders and rams supporting the pressure on the roller bearing. The device of the present invention consists of a ring having one or more projecting cam surfaces or steps which can be turned round to engage with corresponding locking lugs on the fixed portion of the cap at such times when it is desired to convert the mill into a fixed one and thence enable parts of the hydraulic mechanism controlling the floating bush to be renewed.



As is shown in the figure, the shaft *1* of the mill is supported in a journal *2* which has a bearing cap *3* with a curved surface engaging with a corresponding surface on a block *4*. The block *4* bears against a distance piece *5*, against which the hydraulic piston *6* acts. The piston *6* moves in a cylinder *7*, and is preferably of such type that when the distance piece *5* has been moved away, for instance by being withdrawn laterally through the cut away portions *8* in the sides of the mill cap, the ram or piston *6* can be dropped down and similarly removed laterally from the mill for the renewal of the packing leathers or the like. To enable the mill to be kept running during such operations being meanwhile converted to a fixed mill, a ring *9* on the block *4* is provided having cam portions or steps *10* which normally lie in the positions indicated to allow of free rise and fall of the shaft *1* against the hydraulic pressure in the cylinder *7*, but when it is desired to convert the mill into a fixed one it can be turned round to engage with lugs *11* formed on the fixed portion of the cap so that the block *4* is rigidly locked against outward movement. When the parts of the hydraulic gear controlling the floating of the bearing are replaced and in operative condition, it is then merely sufficient to turn round the ring *9* to restore the hydraulic control to the shaft *1*.

TRASH TURNER FOR CANE MILLS. *James Miller and George Fletcher & Co., Ltd.,* of Litchurch, Derby. *102,034* (*11,074* of 1916). Applied for, August 5th, 1916. Accepted, November 9th, 1916.

In order to provide an easier method of attachment of the turner blade to its support, whereby the blade may be removed from the support while this remains *in situ*, these two parts are connected together by means of co-operating snugs in contradistinction to bolts or the like of previous constructions.

In figure *1* is shown an inverted partial plan view of the blade, while figure *2* is a plan view of the top of the holder. The blade *1* is provided on its under surface with spaced lugs *2*, *3*, adapted to be engaged by corresponding lugs *4*, *5*, on the holder *6*. To fix the blade *1* upon the holder *6* this is placed over the face of the holder *6* with the lugs *2*, *3*, lying over slots or cutaway parts *8*, *9*, in the face of the holder until the snugs *2*, *3*, engage under the corresponding **snugs or** cam surface *4, 5,* of the **holder** *6*. The holder *6* is pivoted or mounted at its lower end in usual manner. In the particular arrangement indicated the trash turner is shown slotted above the middle line of its upper face and provided with spaced snugs adapted to co-operate with spaced snugs on the rib on the blade.

---

[1] Copies of specifications of patents with their drawings can be obtained on application to the following:—*United Kingdom:* Comptroller of the Patent Office, Southampton Buildings, Chancery Lane, London, W.C. (price, 6d. each). *United States:* Commissioner of Patents, Washington, D C. (price 5 cents each). *France:* L'Imprimerie Nationale, 87, rue Vieille du Temple, Paris (price, 1 fr. 05 c. each). The date given in the heading of United Kingdom specifications is that of the application of the patent.

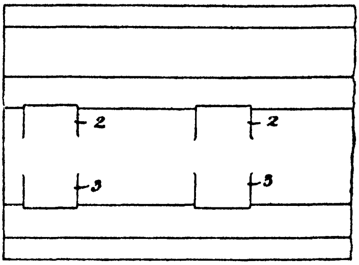


Fig. 1.

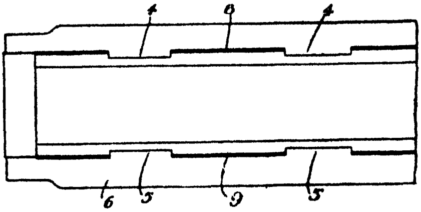
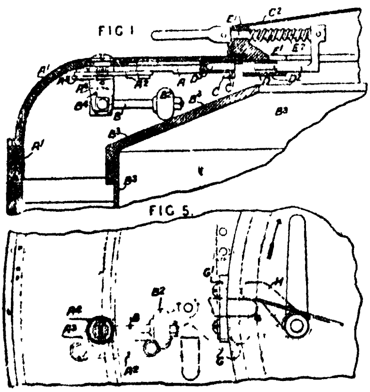


Fig. 2.

It is obvious, however, that the blade may be hollowed or grooved longitudinally and can be provided with snugs along the inner edge of the groove to engage in this instance with corresponding snugs projecting from the edges of the trash turner holder or to form a rib on this.

Locking and Unlocking the Hinged Covers of Centrifugals. *George Aitken,* of 63, Glasgow Road, Rutherglen, Lanark, N.B. *8223.* Applied for, June 3rd, 1915. Accepted, January 27th, 1916.

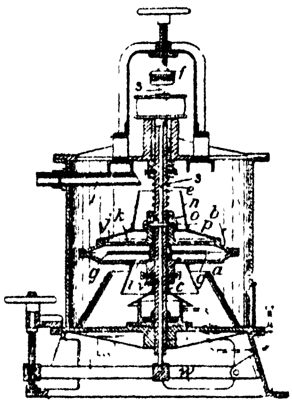
Essentially the invention comprises an endless moveable bolt or a lever on the monitor casing, a roller operatively connected with the bolt or lever, so placed that whilst the basket is running, the roller is kept in such a position that the bolt or lever is shot, a socket or catch on the cover to receive the bolt or lever when shot, a second bolt or arm carried on the cover and capable of projecting into the socket or catch, a handle connected with this second bolt or arm, and a spring so controlling the bolt or arm that it is normally held withdrawn. Preferably a blade spring is provided to bear on and hold the first bolt when the cover is raised, a projection on the cover depressing this spring so as to free the bolt when the cover is closed.



In the Fig. 1 the centrifugal cover is shown at C^2 and the basket at B^3. A roller B^2 is mounted on an arm B pivoted to a bolt A^4 which is free to rotate. When the machine is started, the roller B^2 runs off the basket, carrying the arm B through about 90 degrees. A projection on the hub of the arm B engages a stop B^4 and prevents the arm from falling below the level of the conical end of the basket. The rotation thus imparted to the bolt A^4 moves a bolt A through links A^2, A^3. The bolt A slides on the casing A^1 and engages a socket D in the cover. For pushing out the bolt A when the machine is stopped, a bolt D^2 is provided adapted to engage a socket D^3 in the bolt A. This bolt D^2 is operated by a handled spindle E^1 against a spring E^2. This operation replaces the roller B^2 on the basket B^3 and cannot be done with sufficient speed to allow the cover to be opened while the basket is revolving. A spring C holds the bolt A while the machine is stopped ; it is depressed by a projection C^1 on closing the cover. In a modification, Fig. *5*, the sliding bolt A is replaced by a pivoted lever G which engages a catch G^1 on the cover. The lever is pushed out, on stopping, by a spring-held lever H.

Centrifugal. *Charles S. Watson*, of Crossways, Newcastle-upon-Tyne. *8385.* Applied for, June 4th, 1915. Accepted, March 2nd, 1916.

An improvement is claimed in centrifugal separators, more especially of the kind in which separation takes place in a compartment constructed of parts that meet at their peripheries and are axially separable, the heavier content being discharged between the peripheral portions of the parts. According to the present invention the separable parts are constituted by dished plates mounted face to face upon a vertical shaft within a casing; usually the lower plate is fixed to the shaft and the upper one left movable thereon in opposition to a spring to an extent limited by an externally adjustable abutment, it being understood that the spring acts to keep the dished plates together when starting and until the axially directed component of the force due to the wedge-like mass of material under centrifugal action reaches a critical value.



Referring to the figure, the centrifugal separating chamber is formed by two dished plates *a*, *b*, the former being secured to the shaft *c*, and the latter sliding axially thereon against the action of a spring *e*. The liquid to be treated is fed by a pipe 1 into a hood *n* carried by the plate *b*, and passes through holes *j*, *k* into the chamber. The clear liquid escapes through holes *i*, and when solid matter has accumulated at the periphery, it forces up the plate *b* and escapes gradually. The boss *o* of the upper plate *b* carries a cross-bolt *p* on which rests a rod *s* adapted to contact, through a ball bearing, with an adjustable stop *f*, by which means the travel of the plate *b* is limited. The arrangement of the stop *f* may be modified. The plate *b* may be raised, while the machine is stationary, by a hand-operated lever *w* and a rod *v*. A plate *g* is arranged in the separating chamber. Its outer edge may be bent up or down, or may be forked, and the disk may be fixed or axially movable against a spring. The separating chamber, and the passage leading to it, may be fitted with plates for subdividing the streams.

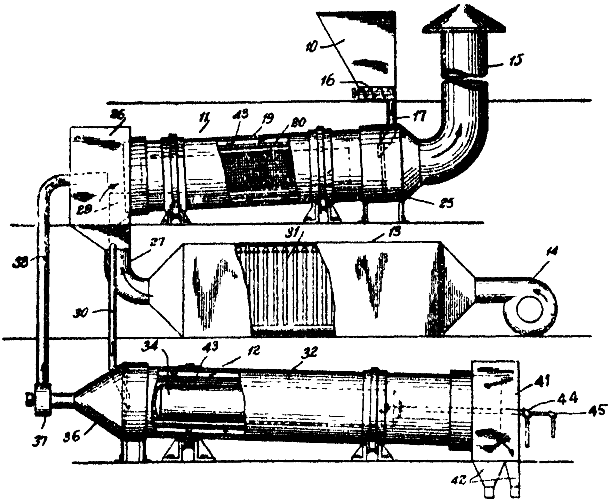
UNITED STATES.

Granulating and Drying Sugar. *Godfrey Engel*, of Brooklyn, New York. *1,216,554.* Patented, February 20th, 1917.

One object of the invention is to increase the output of finished product of standard size by using a blast of preheated air and a wire screen cylinder, instead of a steam drum, thereby increasing the capacity of the apparatus. Further, in order to prevent loss of sugar in the form of dust, the drying air laden with the dust is passed through the moist sugar.

The apparatus comprises a wet sugar bin *10*, an upper granulator *11*, a lower granulator *12*, a heater *13*, a fan or blower *14*, a fan or blower *37*, and a stack or ventilator *15*. The upper granulator *11* comprises a hollow cylinder *19*, rotatively mounted and somewhat inclined, and a concentric cylinder *20*, formed of a wire screen, and fastened to the inside of the hollow cylinder *19*. Within the stationary box *26* and in position to receive sugar discharged from the drum *19*, is a hopper *29*, which is connected by a pipe *30* to the lower granulator *12*. The heater *13* is interposed between the fan or blower *14* and the pipe *27* and comprises a casing or box in which a coil of steam pipe *31* is disposed. Air is delivered from the fan or blower *14* to the heater and after its temperature is raised by the steam coil, it is forced upwardly from the pipe *27* and through the upper granulator *11*.

The lower granulator *12* comprises a rotatable cylinder or drum *32*, which is similar to the drum *19* and is similarly supported. Within the drum *32* is a steam drum *34*, which is co-axial with the cylinder *32* and is fastened to the inside of same. A stationary funnel-shaped box *36* is fitted over the intake end of the cylinder *32* and is connected through a fan or blower *37* and a pipe *38* to the box *26*. The pipe *30* which leads downwardly from the hopper *39* is adapted to discharge the sugar received from the upper granulator into the lower granulator. The cylinder *32* at its discharge end is provided with a wire screen cap *40* and extends into a stationary open box or bin *41* from which the dry sugar is discharged in granular form through one or more spouts *42*. The blower *37* produces a draught of air through the lower granulator and then through the upper granulator where it is in parallel with that produced by the blower *14*. Each of the granulator cylinders *19* and *32* is provided on its inner surface with a plurality of inwardly projecting blades or buckets *43* for the purpose of carrying the sugar upward as the cylinder rotates and dropping it upon the disseminating screen drum *20* or the steam drum *34* as the case may be.



The first part of the process consists in elevating and dropping wet sugar in an air passage and passing a large volume of warm air through the passage This is accomplished in the apparatus above described by the blades or buckets *43* within the cylinder *19*, which carry the wet sugar, fed into the cylinder by the screw-conveyor *16*, upwardly and drop it onto the wire disseminating screen cylinder *20*. The warm air is supplied by the blower *14*, which forces air through the heater *13* and upwardly through the cylinder *19*. The next step consists in elevating and dropping the sugar which has been dried to a greater or less extent in a second air passage and passing through a volume of cool, dry air through the passage. This volume is relatively small since the unobstructed cross-sectional area of the passage is smaller relatively to that of cylinder *19*. This portion of the process is effected by the apparatus shown, the sugar being discharged from the lower end of the cylinder *19* through the pipe *30* into the cylinder *32*, which serves to carry the sugar upwardly and drop it upon the steam drum *34*. The blower *37* supplies the air which is drawn through the lower cylinder. Another step in the process consists in the passing of the air from the second passage through the first passage together with the larger volume of warm air. This is also accomplished by the blower *37* which forces air from the cylinder *32* through the cylinder *19*. These devices all effect the drying of the sugar, the screen serving to separate the sugar into fine granular form as it falls and hence enabling it to dry more quickly, and the steam cylinder being located in the path of the sugar so that it falls upon it and is heated and thoroughly dried.

MANUFACTURE OF A DECOLORIZING MATERIAL. ***R. M. Catlin***, of Franklin Furnace, New Jersey, U.S.A. *1,219,438*. Patented, March 20th, 1917.

A carbonaceous material obtained from an industrial carbonizing process as, for example, the residue of shale distillation, is mixed with silica, and treated with dilute hydrofluoric acid. The solid residue, which possesses decolorizing properties, is separated and dried.

Freeing Lump Starch from Powder. *A. W. H. Lenders*, of Cedar Rapids, Iowa, U.S.A. *1,223,406*. Patented, April 24th, 1917.

Manufacture of Starch and its Products. *C. G. Moore*, of Washington, D.C., U.S.A. *1,224,951*. Patented, May 8th, 1917.

Plate for the Microscopic Examination of Syrup during its Concentration in the Vacuum Pan. *William A. Baldwin*, of Haiku, Maui, T.H. *1,205,838*. Patented, November 21st, 1916. (Six figures.)

By means of this plate a sample of definite volume may be trapped from the vacuum pan whenever desired, and held for examination under the microscope in order to enable the number of crystals present accurately to be counted and thus to ascertain the right moment at which to arrest the formation of grain. It consists of a glass plate provided with a central pocket, which, after being filled from the proof-stick, is closed by a sliding glass cover. This device as an entirety is placed under the microscope and the number of crystals and their size observed. In order to enable a count to be made, either the bottom of the pocket, or else the sliding cover, may be ruled with cross-hairs.

UNITED KINGDOM APPLICATIONS.

Cane Mills. *Fawcett, Preston & Co., Ltd., H. W. Taylor, and A. M. Lang. 10,985*. July 31st.

Centrifugals. *T. W. Barber. 10,927*. July 30th.

Production of Fruit or Beetroot Extract, and Method of Employing it in Jam and Cider Manufacture. *C. Chatillon and G. Quarré. 11,167*. August 2nd.

Production of Saccharic and Pyrotartaric Acids from Carbohydrates. *Diamalt-Akt.-Ges. 11,302* August 4th. (Germany, August 4th, 1916.)

Preventing Deposition of Water upon the Object Glasses of Optical Instruments. *A. Hilger, Ltd., and F. Twyman. 11,356*. August 7th.

Meters for Measuring Flow of Liquids. *Sugar Centrifugal Discharger Co. (E. C. R. Marks). 11,458*. August 9th.

Method of rendering Alcohol more readily Ignitable when used as Fuel in Internal Combustion Engines *A. J. Stoneman. 11,478*. August 10th.

Cleaning Filters used for the Purification of Sugar, Oils, and Chemicals. *P. L. Wooster. 11,541*. August 10th. (United States, August 17th, 1916.)

Manufacture of Alcohol. *H. Dreyfus. 12,235-6*. August 25th. (France, March 22nd, 1917.)

Centrifugal Machines. *C. J. H. Penning. 12,356*. August 28th.

Centrifugals. *R. A. Sturgeon. 12,750*. September 5th.

Evaporators. *R H. F. Findlay. 12,837*. September 7th.

Cooling Sugar while Filling into Moulds. *G. A. Widström. 13,092*. September 12th. (Germany, June 30th, 1915.)

Manufacture of Superphosphate. *G. A. Mower and F. W. R. Williams. 13,334*. September, 17th.

Removal of Incrustation from Boilers. *J. M. J. Coadie. 13,404*. September 18th. (France, February 24th, 1916.)

Obtaining Inulin and Levulose from Plants. *A. Daniel*. September 18th. (Germany 18th, 1916.)

Brevities.

The increasing use that is made of fertilizers on the Hawaiian sugar plantations is shown from the fact that while in 1913 some 62,000 tons were employed, the quantity to be used this year will total 85,000 tons.

The Cuba Cane Sugar Corporation is experimenting with the Luce harvesting machine on its estates in Cuba and two more of these machines are to be delivered to Central Mercedes, making six in all at work on this estate.

The firm of Messrs. A. & P. W. McOnie, of Glasgow, having lately gone out of business, have disposed of the goodwill with all their drawings, patterns, and models of sugar machinery to Messrs. Blair, Campbell & McLean, Ltd., of the same district of Glasgow; the latter firm have been connected with the sugar industry for upwards of 70 years, and have a high reputation for turning out first-class work.

As showing the increased favour with which the decimal system is held in British commercial circles, it may be mentioned that the Chartered Institute of Secretaries in the United Kingdom on circulating a *questionnaire* amongst its members got by way of replies 85 per cent. in favour of a change to a decimal system of coinage, and 66 per cent. in favour of the pound sterling as the unit of measure instead of the imperial crown or dollar unit. As regards weights and measures, 86 per cent. favoured a change to the metric system.

The persisting unsettled condition of the Chinese market and the increase in the Formosan sugar production threaten the Philippine sugar industry with the loss of both its Chinese and Japanese markets, which have hitherto between them taken the bulk of the muscovado production. As a consequence stocks are accumulating and run to about 100,000 tons. Efforts are therefore being made to get the United States to acquire the surplus. But freight rates are too high to enable Philippine sugar to reach the Pacific ports of the States and be sold there at a profit in competition with other sugars.

According to the *Louisiana Planter's* Hawaii correspondent, the Atlantic refiners who now take Hawaiian sugars complain that these are not up to the standard of Cuban raws for refinery purposes. Two of the most common complaints are (1) that the grains are too small in size and lack uniformity, and (2) that such a large amount of sulphate of lime is present, which forms a heavy scale in the evaporators and affects the output. The first complaint, according to Dr. Norris, can easily be remedied by a slight alteration in the boiling departments, but the second one is a more difficult problem and will require considerable thought and experimentation if a solution is to be found.

The first cane crop forecast for the 1917-18 season in India, which is based on official reports covering about 95 per cent. of the total area under sugar cane, shows that some 200,000 more acres in India are under cane than in the previous season. The figures for the different Provinces are as follows:—

Provinces.	1917-18	1916-17.	Increase + or Decrease —
United Provinces..	1,342,000	1,220,000	+122,000
Punjab	446,000	360,000	+86,000
Bihar and Orissa..	265,000	270,000	—5,000
Bengal	209,000	223,000	—14,000
Bombay and Sind (including Native States)	92,000	80,000	+12,000
Assam	34,000	35,000	—1,000
North-West Frontier Province..	30,000	32,000	—2,000
Central Provinces and Berar	24,000	22,000	+2,000
	2,442,000	2,242,000	+200,000

It is added that seasonal conditions at sowing time were favourable, and the prospects for the crop are so far good.

United States.

(Willett & Gray, &c.)

(Tons of 2,240 lbs.)	1917 Tons.	1916 Tons.
Total Receipts January 1st to September 13th	2,101,868	2,220,512
Receipts of Refined ,, ,,	—	—
Deliveries ,, ,,	2,112,833	2,116,519
Importers' Stocks, September 12th	—	108,071
Total Stocks, September 12th	118,178	237,771
Stocks in Cuba, September 12th	181,463	353,084
	1916.	1915.
Total Consumption for twelve months	3,658,607	3,801,531

Cuba.

STATEMENT OF EXPORTS AND STOCKS OF SUGAR, 1914-1915, 1915-1916, AND 1916-1917.

(Tons of 2,240 lbs.)	1914-15 Tons.	1915 16. Tons.	1916 17. Tons.
Exports	2,044,726	2,541,422	2,639,710
Stocks	388,633	361,876	232,901
	2,433,359	2,903,298	2,872,611
Local Consumption	56,300	60,000	72,000
Receipts at Ports to August 31st, 1917	2,489,659	2,963,298	2,944,611

Havana, August 31st, 1917

J. GUMA.—L. MEJER.

United Kingdom.

EXPORTS OF SUGAR.

	MONTH ENDING AUGUST 31ST.		EIGHT MONTHS ENDING AUGUST 31ST.	
	1916. Tons.	1917. Tons.	1916. Tons.	1917. Tons.
BRITISH REFINED SUGARS :—				
Refined and Candy	272	52	3,965	735
Total	272	52	3,965	735
FOREIGN AND COLONIAL SUGARS :—				
Refined and Candy	135	10	824	19
Unrefined	1,919	99	3,133	512
Various Mixed in Bond	—	—	—	—
Molasses	177	3	804	20
Total Exports	**2,503**	**164**	**8,726**	**1,286**

Sugar Market Report.

The most important event in the sugar world since the issue of our last Report, dated 8th May, 1917, has been the action of the Washington Food Commission in taking charge of the purchase of raws for the American refiners, controlling the sale of refined sugars, and forbidding all speculative transactions in the New York terminal market.

It has been decided that purchases of Cuban raws and American granulated made hitherto (for account of the United Kingdom, France, and Italy) by our own Royal Commission shall be effected through, and in conjunction with, the Washington Commission, two British representatives having been appointed to proceed to America and confer with the Washington Bureau.

Already, it is reported that Cuban producers have expressed their desire to agree upon reasonable terms for the sale of their new crop sugars; it is rumoured that contracts may be arranged on the basis of about 4 50 cents per lb. (say about 21s. 3d. per cwt.) f.o.b. Cuba. A rigid control will be exercised over imports of American granulated, and special licences must be sought for independent shipments.

Estimates of the next Cuban crop are in circulation, ranging between 3,200,000 and 3,500,000 tons as against about 3,050,000 tons for the campaign now concluding.

Ample crops of sugar during the 1917-18 campaign are in prospect, and were it not for the imperative necessity of economising tonnage, the United Kingdom and the United States could doubtless contract supplies on a pre-war basis of quantity.

A crisis has occurred in the Java market; heavy speculative purchases of the 1917-18 crop (commencing in May, 1917) were encouraged at the close of last year by the success of earlier operations, but owing to the difficulties of lifting for export the rapidly accumulating production, several local Chinese speculators became involved in financial difficulties and the mills were reluctantly forced, in protection of their own interests, to take back a large proportion of their sales. A combination was formed of millowners and bankers to arrest the panicky tendency of the market, and this syndicate now controls the bulk of the remaining stocks and balance yet to be produced.

The tonnage question, as affecting shipments to Europe, has been sufficiently serious for Java; but her difficulties are now added to by the requisitioning of British tonnage, hitherto employed in her trade to India; shipments have been greatly delayed, and, for the time being, it is impossible to book freights for either near or distant deliveries to certain leading ports; it is believed, however, that these difficulties will be, at least partially, overcome at an early date, by the employment of Dutch tonnage.

Cable advices from Java announced recently the purchase, for account of the Royal Commission, of some 150,000 tons 98 per cent. Java browns at the equivalent of about 13s. 6d. per cwt. f o.b., but there is neither official confirmation nor contradiction of this report. If correct, however, the price indicated shows a decline of about 1s. 6d. per cwt. from the basis upon which business had been previously negotiated for account of other interests.

H. H. Hancock & Co.

10 & 11, Mincing Lane,
London, E.C. 3,
3rd October, 1917.

THE

INTERNATIONAL SUGAR JOURNAL.

No. 227. NOVEMBER, 1917. VOL. XIX.

☞ All communications to be addressed to "The International Sugar Journal," 2, St. Dunstan's Hill, London, E.C.

Cheques and Postal Orders to be made payable to "The INTERNATIONAL SUGAR JOURNAL," and not to individuals

☞ The Editors are not responsible for statements or opinions contained in articles which are signed, or the source of which is named.

The Editors will be glad to consider any MSS. sent to them for insertion in this Journal and will endeavour to return the same if unsuitable; but they cannot undertake to be responsible for them unless a stamped addressed envelope is enclosed.

Notes and Comments.

Sugar Rationing at Home.

No new features of the sugar régime in the United Kingdom have developed of late; the sole point of interest has been the organization of the new system of sugar rationing. This has not been hurried, it being intended that the arrangement shall not come into force till the new year has dawned. This lengthy preparation has been rendered necessary not only on account of the vast amount of labour involved in tabulating and ticketing all the families in the land; but it is fairly evident that this classification is meant to serve if need be for other rationing restrictions which the exigencies of the near future may dictate, and it is desirable to give time to organize a system which may have to serve as the basis of others; for if the sugar rationing fails through faulty organization, all other subsequent steps in rationing are rendered similarly defective unless speedy reorganization is effected—practically an impossibility. On the other hand if the system when put into full swing proves a success, it will need comparatively little extra labour to apply its machinery to the rationing of the population as regards other foodstuffs, bread for example. This explains why the documentary preliminaries which have seemed to some households unnecessarily detailed inquisitions have been insisted on by the authorities, even though it has given no end of trouble to the clerical staffs dealing with them on account of the inability of a surprisingly large percentage of the population to understand the proper manner of filling up the forms supplied to them. Thus an imaginary address given them as an *example* has been taken (very illogically it would have been thought) to be either the address to which the forms had to be sent or even the address which the applicant himself has to give as his own! As a consequence a large number of forms in some districts either went astray or were wrongly filled up; and the liberal time allowed the Rationing Committees to get their districts ticketed will probably prove none too long for enabling all the families to be registered, so that when the sugar supply is strictly rationed there shall be no large percentage of defaulters left outside the scheme whether from ignorance or by accident.

The Sugar Situation: Official American Report.

The United States Food Administration issued at the end of September a report on the sugar situation, and on the steps they had taken and proposed to take to deal with it. The report is too long to reproduce *in extenso;* but the following is a summary of its chief points.

Sugar, they state, represents an entirely different problem for the Food Administration from almost any other commodity they have to handle, in view of the fact that about half the United States consumption is imported. Cuban sugar is the dominating factor in the New York market, which in its turn governs the trend of prices for the domestic supplies from Louisiana, Hawaii, Porto Rico, and the domestic beet area. It is therefore the intention of the Food Administration to enter into negotiations with the Cuban Government and the Cuban planters to see whether a voluntary agreement cannot be reached fixing a price for Cuban sugar in New York that will be satisfactory to the Cuban producers, and at the same time ensure a fair price for the consuming public in the United States. It is hoped that negotiations will prove sucessful.

In order to handle the situation and arrange for the distribution of the available sugar in the world, an International Committee of five members has been formed, of whom two are the nominees of the Allied Governments, viz., Sir J. WHITE TODD and Mr. JOHN V. DRAKE, while the remaining three consist of Americans, being Messrs. EARL D. BABST, President of the American Sugar Refining Company, and Mr. W. A. JAMIESON, of Messrs. Arbuckle Brothers (neither of whom is interested in any way in the production of Cuban sugar), with Mr. GEORGE M. ROLPH, Head of the Sugar Division of the Food Administration, as the Chairman. It will be the duty of this Commission to arrange for the purchase and distribution of all sugar, whether for the United States or the Allied countries. In addition, the three American members will serve as a subcommittee to handle and decide purely domestic questions with which the Allied members are not concerned.

Conferences held in Washington and New York have resulted in a voluntary agreement for the duration of the war, whereby the refiners undertake not only to obtain their supplies of raw sugar under the direction of the International Sugar Committee, but have also agreed to work on a stipulated margin which has been fixed at 1·30 cents per lb. This figure has been arrived at by taking the average margin for five years previous to and including 1914, and adding the increased cost of operation which the refiners must now face. But although the actual net margin of profit allowed the refiners is no more than the pre-war basis, they will gain an advantage through their ability to run their plants at full capacity for nearly the entire year, due to the large increase in export business which is now obtainable.

The new system of co-operative buying between the refiners and those purchasing raw supplies for England, France, Italy, and Canada, with the resultant elimination of competitive buying, is expected to save consumers many millions of dollars, and to prevent the rapid fluctuations in prices which we have seen since the outbreak of the war in 1914. Consumers' interests will be subjected only to the law of supply and demand.

At an early date conferences will be held between the Committee and a large body of representatives of the Cuban planters either in Washington or New York, when the question of price for Cuban sugars will be gone into. But it is realized that the cost of producing sugar in Cuba has advanced greatly within the past three years, due to increasing cost of labour, of supplies, of freight rates, of bags, and increased taxes; and it is realized to be essential that fair profits be allowed to all producers, in order that production be not discouraged. Increasing the production of sugar to-day is just as important, if not more so, than reducing the price to the consumer, since the European military requirements of this most important food product must be kept up.

The report then refers to the recent introduction into Congress of a proposal to eliminate the drawback on export, and records that it led foreign buyers to bid direct for Cuban sugars, and a violent speculation in the latter was started, with the result that the price advanced in a little over a month from 5·77 to 7·77 cents. This speculation was only stopped when it was announced that the Food Administration had come to an arrangement with the domestic beet sugar producers to maintain a price not exceeding 7·25 cents for their production of this autumn. If this speculation in Cuban sugar had not been checked, it is not unreasonable to believe that sugar would have been selling wholesale to-day at prices ranging anywhere from 10 to 12 cents per lb. This point alone demonstrates conclusively the value to the United States of a domestic grown product. Aside from the Louisiana cane representing about one-third of the beet production, and combined with the beet representing a total production of a little over one million tons, there is no sugar that would be available in the United States if their coasts were blockaded by foreign powers, such as Germany's now are. But this million tons of domestic production represents less than 25 per cent. of the consumption of the country. It is evident, therefore, that every encouragement should be given to this, " one of our most important domestic industries."

Finally, it is stated that the Pacific coast refineries have notified the Food Administrator that they will join with the beet interests and keep the price of cane sugar in their half of the United States down to the 7·25 cents basis; but they declare that it will result in tremendous losses to their interests, as they will be selling their refined product on the basis of what the raws cost them.

The Cuban Position.

The above report shows what an important factor in the situation the Cuban crop now is. There was a time when Cubans were less favoured, and were forced by pressure from the States, and lack of storage in their island, to sell their crop at a figure which was below that of other raw sugars entering the United States market. Now the tables seemed turned with a vengeance, and the Cuban producer has the situation in his own hands. Two circumstances there are, however, which should tend to bring along a reasonable solution of the price question. One is that Cuba is within the ranks of those countries which have ranged themselves against Germany, and she is sure to realize the importance of not interfering with the flow of food supplies to the Allies who are actively engaged in the war. The other is that a large proportion of the Cuban producing interests are now owned and administered in the United States, and it is hardly likely that their proprietors will be less amenable to the persuasions of the Food Administration than are the domestic sugar producers. But the Cubans will doubtless see to it that the position of Cuba as a leading sugar producer is recognized for good and all, and that after the war they have a freer hand in the disposal of their production than they have had in the past.

The Extent of the American Control of Sugar.

Some misunderstanding has arisen as to the extent of the American Food Administration's control of sugar, owing to the fact that press reports generally have failed to define the geographical limits of operation, and it has been concluded that the American Sugar Committee were becoming responsible for the sugar supply to the Allies from all over the world. But as we suggested last month, they are not concerned with the supplies of sugar from the East, which will remain as heretofore within the sphere of the British Food Controller. Official pronouncements correcting this misconception have had to be issued on both sides of the Atlantic; in England the Royal Commission on the Sugar Supply point out that the functions of the American Sugar Committee of Five are strictly limited to the purchase on behalf of the Allies of the sugars required by them from Cuba and the United States of America. The purchase of sugars required by the Allies, including the United States, from markets other than those indicated will be undertaken by the Royal Commission, who, it is observed, represent not only the interests of the United Kingdom, but also certain of the Allies in Europe. The American Committee, moreover, are not concerned in any way with the allocation of the sugars they purchase for Europe, this task being left to the Royal Commission.

The American Food Administration, on their part, announce that there is no truth in the statement that they are making efforts to send ships to Java to secure an increased supply of sugar for the United States. The American Government is not interested in Java sugars, as such sugar could not possibly arrive before the beginning of the new Cuban crop, which latter will ensure ample supplies for next year's requirements.

It is clear, then, that Java producers will have to look to British purchases to reduce their large accumulations of sugar, apart from what stocks they can send to the Japanese and Chinese markets. As for the Philippine sugar, the United States will naturally be responsible for any that may be shipped for Allied account.

Supplies and Renewals.

The war has done the sugar industry generally a good turn in raising prices to a lucrative level; but some of the causes which have operated to produce this result are tending to hamper in increasing ratio the sugar producer; and it may well be (if the war is prolonged over 1918) that the difficulties of carrying on on sugar estates will be great enough before long to affect the production to a material extent.

As matters stand at present, the scarcity of shipping, the high cost of freights, the prior claim of Governments on supplies of chemicals, the veto on exports of various kinds, the delay in getting export licences, the limited range and the cost of packing, whether wood or metal—all contribute to make it a slow and tedious if a possible task for sugar plantations in distant parts of the world to get renewals of machinery, implements, and chemicals. As regards packing, for example, the price of some chemicals, such as lime, even though higher than in pre-war days, is still a mere trifle compared to the cost of the metal containers in which it is sometimes a *sine quâ non* that the substance shall be shipped; and it is getting a fortunate circumstance if one can obtain metal drums at all, while metal tanks are now quite unprocurable in the United Kingdom. If one endeavours to fall back on casks and barrels, the shipping companies as often as not advance a *non possumus*.

The necessity of getting licences to export goods or even to have them manufactured within a reasonable time is no doubt inevitable in war time when the claims for war material are paramount. The result is, however, that when a mail order for goods has survived the submarine menace, and arrives at its destination after a tedious voyage, delay which may run to months occurs in getting the said goods manufactured, and finally, when the shipment is effected very late in the day, it is quite on the cards that the consignment may after all find its last destination at the bottom of the sea, and a repeat order must be attempted. Such is the incidence of trade under the conditions of war which rule at present.

The result is bound to be that some plantations will be held up for lack of supplies; either implements for the harvest field, or chemicals for the factory, or spare parts for the milling or boiling plant, will fail to turn up in time for the cane season. Managers will have to make shift with existing supplies and stocks; but in the absence of chemicals the production of anything else than a very impure raw sugar will be rendered an impossibility.

We have roughly stated the conditions which more or less rule in the United Kingdom after over three years of waging war against Germany. The United States has hitherto been free to pursue her trade vocations almost unmolested. But now on her entry into the war with a zest that leaves little or nothing to be desired, it is highly probable that sugar estates which look to that country for supplies will before long meet with the same difficulties of getting delivery. Stocks of all materials will speedily fall below their peace-time levels, and ships will be fewer and more costly in freight charges.

However, the chief thing is to win the war, and put a stop to the German military aggression which has temporarily destroyed the peaceful pursuits of the whole world in an insane attempt to secure national aggrandisement at the expense of weaker communities. For that reason all efforts must be concentrated on its accomplishment, and production must meanwhile be prepared to suffer. But production may as well make the most of the opportunities left it; and as regards the sugar industry, it must make up its mind to an increasing scarcity of supplies, and must endeavour to take time by the forelock to an unprecedented extent. So those who are wise will order their needs sufficiently in advance that a delay of months even is of no moment; and they will husband their supplies and avoid all waste, so as to have the means to carry on, even if at a restricted rate, till the day when supply and transit are once more normal. And it must be remembered that the end of the war will not restore that condition in a day. Demobilization of military establishments, and the re-mobilization of trade activities and the restoration of lines of communication, will all take a considerable time to accomplish.

French Sugar Properties recovered from the Enemy.

The *Syndicat des Fabricants de Sucre* recently commissioned M. E. SAILLARD and M. BARROIS-BRAME to undertake a tour of investigation in the sugar producing districts lately recovered from the enemy in France and report on the condition of the factories, plant, and fields. M. SAILLARD having likewise a similar mission to perform for the French Government, the deputation were afforded all necessary facilities for touring the districts concerned in a military motor car and were thus enabled to make a thorough investigation, including the taking of photographs. These gentlemen have now issued their report, and we give here a summary of the detailed account which recently appeared in the *Journal des Fabricants de Sucre.*

In the territory liberated there exist—at all events the remains—of more than 40 sugar factories, not counting some others which while not in actual enemy occupation are yet still too near the battle line to be capable of investigation. Of these 22 are in the Somme Department, 15 being round Peronne, while seven are in the Aisne and six in the Pas de Calais.

It is pointed out that the restoration and reconstruction of the factories is intimately connected with the possibilities of once more cultivating the liberated fields. Thus in the zone lying between Arras on the north and Peronne on the south the territory is so devastated by shell fire and mine explosions, that the subsoil has been brought to the surface and the old arable layer has disappeared. In addition there are no end of unexploded shells and bombs yet buried in the soil which would constitute a grave danger to agricultural operations. It will therefore be difficult to restore this region.

In the Soissons district the fields have not been much damaged and could soon be put into cultivation again, if cultivators were available. Villages have been as a rule greatly damaged if not destroyed, while agricultural implements where they have been left behind are all in a more or less delapidated condition. The factories in this district are greatly damaged and are stripped as a rule of all their copper and bronze accessories and fittings, while their chimneys have been mostly mined. As a rule the only factories anywhere which have escaped more or less complete destruction and stripping of valuable metal are those which were behind the farthest line of advance of the enemy in 1914, but within the zone of shell fire.

In the environs of Arras the destruction of the terrain is also incomplete, and can soon be restored for cultivation; but the only factories which are likely to be restarted with any expedition are those which have not been within enemy possession, but only been subject to fire. Those not so favoured have been more or less completely destroyed. Generally speaking, the degree of destruction of any factory has been proportional to the time it has been within the zone of enemy occupation and those which have been liberated since the battle of the Somme inaugurated the slow but steady British advance, have been the most completely destroyed.

There have been suggestions in British papers that the ground recovered during the operations of the last 15 months is too devastated by shell and mine explosions to be capable of cultivation for many a long year, and that it will need to be afforested. Much however depends on the nature of the subsoil, and it is clear from the above report that in some districts at all events the bringing of the subsoil to the surface will destroy for a long period the fertility of the land. On the other hand, it is suggested that the destruction of all woodland will increase the farming area, while the disturbance of the soil where not too great will increase its fertility. But if the present method of fighting by making short advances after very heavy shelling is continued over the remaining beet areas still in the occupation of the enemy, it does not look as though any ordinary cultivation would be possible there for a long while to come. And amongst these areas lie the eight largest beet sugar factories in France.

Progress in the Philippines.

Under Government influence there is a scheme in progress in the Philippine Islands to divorce the sugar manufacturing interests from the cane growing ones and enable the raw material of the factories to be produced by cane farmers. The Welch and Havemeyer interests which have been the owners of the cane lands so far are going out of the cane growing business and confining their future operations to the manufacture of sugar. This scheme, according to an American contemporary,[1] is being inaugurated by the formation of a new corporation, authorized by Act of Legislature last May, which under the title of the Mindoro Sugar Company is to take over the holdings of the former Mindoro Company and the San José Estate, thus acquiring some 57,000 acres of land, which are to be improved and then resold to small holders in parcels not exceeding about 1000 acres each. The Act further authorizes the Corporation to establish a system of irrigation for the entire tract. A period of 30 years is allowed for establishing it and for clearing, subdividing, and selling the estate. At the end of the period the irrigation system and any portion of the estate remaining unsold revert to the Philippine Government. Mr. GEORGE H. FAIRCHILD is the ruling spirit in the new venture.

---

[1] *Facts about Sugar.*

As the Corporation itself is forbidden to engage in agriculture, its interest will be confined to seeing that the estate is parcelled out to the greatest advantage, and sold to farmers who may be relied on to cultivate it regularly. The Filipinos are showing great eagerness to acquire portions of the estate, and it will tend to consolidate the agriculture of the country when the native population is given the opportunity to farm the land and at the same time learn the advantages of producing sugar at one modern central mill instead of each estate owner turning out his own crude product. This new form of co-operation between the native cultivators and the foreign factory owners should greatly strengthen the sugar industry of these islands, and place it on a more modern footing, such as has been done in Cuba where most of the cane is grown for the mills by small farmers.

A Cheap Agricultural Motor.

No more striking conversion to a recognition of the justice of the Allies' cause against Germany has been recorded so far than that of Mr. HENRY J. FORD, the American millionaire motor car manufacturer. Early in the year he made the mistake, with a number of pacifists and peace cranks, of assuming that Germany could be talked into reason; and the abortive peace expedition of an American ship to Sweden was the result. But the trip opened his eyes to the reality of things; and now we find him engaged in the task of making for the British Food Production Department some 6000 Ford tractors at cost price, in the hope that, used under Government control, they may serve as a weapon to help the British farmer to co-operate with the Navy and Army in beating Germany.

But it must not be supposed that the Food Production Department have accepted them as a gift horse, and therefore have not looked in the mouth. Actually their acceptance is the outcome of some expert tests carried out under the auspices of the Royal Agricultural Society of England. The judges included some of the leading authorities in engineering and agriculture and agricultural engineering, and after an exhaustive practical trial (in which we assume other makes of tractor were investigated), they recommended last May that steps be taken to construct immediately as many of these Ford tractors as possible, so that the large amount of extra land which has to be brought under the plough in England might be expeditiously tilled. As the exigencies of war prevented these tractors from being made in England, as was at first intended, they have all been ordered from the Ford works in the United States.

This particular tractor is pronounced by LORD NORTHCLIFFE to be a miracle of mechanical ingenuity; though no larger than an ordinary Ford car, it can be used either as a stationary engine, or to propel ploughs, mowing machines, reapers, and binders. Roughly speaking, it resembles one of the early racing motors, with a very long bonnet. It is low, steered by a wheel, and when pulling a set of disc harrows seems fairly to romp across the country. The engine is of 25 H.P., and the machine is virtually fool-proof. It is started with petrol and driven by paraffin, and has a strong electric headlight so that it may just as easily plough by night as by day. And Mr. FORD hopes that one day when the war is over and things are normal this tractor may be sold to small farmers for less than £100!

The Defence of Industry.

VI.

THE VICISSITUDES OF THE BRUSSELS CONVENTION.

France has denounced the Brussels Convention. It was better to do so than to leave any uncertainty as to whether the Convention died a natural death at the outbreak of the war or not. We stated very distinctly our view at the time, that it could no longer exist. Now assurance has been made doubly sure, and the time has come to take a brief retrospect and survey of past events since the memorable International Conference at Brussels in 1901-2.

One outstanding fact dominates the whole period of the life of the Convention, 1903-14, namely, that the question whether a duty to countervail a bounty is or is not consistent with Free Trade has not yet, so far as party politicians are concerned, been settled. Every event in the fluctuating career of the Convention shows how persistently the party politician can stick to his erroneous dogma so long as it brings him popularity—and votes. As an abstract economic question the facts, arguments, and evidence are conclusively in favour of the principle of a countervailing duty. The Report of the Select Committee of 1879-80 makes a most categorical declaration that as bounties must gradually "drive the natural production out of competition" the "result to the consumer would be very mischievous. Hence it is of the utmost importance to the consumer that the natural sources of supply should not be destroyed."

Events proved the correctness of this forecast. Moreover, even the late LORD FARRER, the most energetic of all the opponents of the Convention, inadvertently furnished one of the strongest arguments in favour of that particular form of the defence of industry which the Convention carried out, when he wrote, in 1889, that "Above all, in all these [bounty-fed] countries, however much manufacture and export may have increased, there is great distress among the protected classes. Protection and bounties have produced their usual results—viz., an unnatural stimulus and large immediate profits, followed by a glut, collapse, and ruin." The object of the Convention, so far as Great Britain was concerned, was to defend British sugar industries against the effects of glut, collapse, and ruin.

Two more quotations may be given in support of the assertion made by Mr. CHAMBERLAIN in his famous speech in the House, in 1899, that "there is no justification whatever in the writings or speeches of any of the great Free Traders of the doctrine that countervailing duties are opposed to the principles of Free Trade." In May, 1902, when sugar was a burning question, M. YVES GUYOT, the famous French Free Trader, eminent economist and editor of the *Siècle*, read a paper before our Royal Statistical Society, exposing the vices of the bounty system. In conclusion he said that the President of the Sugar Conference at Brussels "stated clearly enough the importance of the work which the conference had done, nor did he exaggerate when he declared that the 'Convention is a work of international solidarity based on the most rational principles of economic science.' He was also correct in describing it as a work of peace; for by denouncing the system of bounties the delegates condemned protection in its least justifiable form, that of aggression. The success of the sugar conference is the most important achievement of economic liberal policy in Europe since the signing of the Commercial Treaties of 1860."

Sir ROBERT GIFFEN, who was present on that occasion, made a startling and most welcome declaration—a very handsome recantation. He was another of the Board of Trade enthusiasts who did all he could to frustrate our efforts in defence of British industries, especially in his evidence before the Select Committee of 1879. "He was not sure," he said, "that he would have taken the same line then if he had been able to look forward a quarter of a century and see what the result was to be of allowing these bounties to continue. People became wiser as time went on, and a good many of the assumptions which it was perhaps legitimate to make a quarter of a century ago had been falsified by events. But, having had a quarter of a century's more experience, he was satisfied that these bounties must be treated as a great infraction of Free Trade, and that all the countries affected by them were quite entitled to take exceptional measures to put an end to them."

These references to the circumstances under which the Brussel Convention came into being are necessary in order presently to appreciate the strange and shameful—yes, shameful—conduct of the British Government, in 1907, which will constitute one of the main events in our retrospective survey of the life and death of the Convention.

We pass to one or two interesting incidents during the birth of the Convention. It was the violent action of the German and Austrian Cartels, in 1899-1903, which constituted the last straw and broke down the bounty system by its own weight. There was a war of bounties, as one of the French Ministers described it. France piled up its bounties in order to beat Germany and Austria. Then those countries hit upon the happy idea of taking a leaf out of the Russian book. The Russian Government regulated prices in such a way that the industry was perpetually stimulated to increase its production in order to enjoy the high price in the home market. "Let us do the same," said the Austrian and German sugar industries, "by a combination among ourselves, and raise prices in the home market to the extent of the heavy surtax." A very difficult thing to do, but they did it; their Governments shut their eyes, prices rose about £8 a ton in the home markets, production increased by leaps and bounds, visible supplies became excessive, the world's price fell £3 per ton below the cost of production, and the head of the German industry exhorted his brethren to go on over-producing in order to force down prices and crush competition. They would have succeeded if the Convention had not come to the rescue. It was then that the British opponents of the Convention, or some of them, began to say "you have convinced us now, but do not talk about countervailing duties, talk about Prohibition,"—a curious new idea of Free Trade. This is the reason why special permission was given to Great Britain in the Convention, to substitute Prohibition as an alternative for a countervailing duty. The word "duty" was too shocking for the free traders to accept, because without their favourite dogma, which says that Free Trade means "duty for revenue purposes only," they were at sea without rudder or compass. They in their ignorance failed to see, as the present writer pointed out in an article written at the request of the editor of the Journal of the Royal Economic Society (March, 1904), that "a bounty destroys free trade in the country which receives the bounty-fed commodity, because the producer of that commodity is at once placed in a position of favour as compared with his competitors who receive no bounty. The effect is exactly as if the bounty-fed sugar were admitted free and the other, receiving no bounty, were struck with a duty. To eliminate this inequality is the sole object of the countervailing duty. It is, in fact, a duty on bounties, not on sugar. It accepts the bounty for the benefit of the whole nation of taxpayers by putting it into the Treasury, and leaves the sugar to compete with all other sugar on equal terms. Therefore, under a system of countervailing duties we do no injustice to the bounty-fed producer, and we save the consumer from the danger to his interests arising from the effect of bounties in discouraging and eventually destroying his natural sources of supply. None of these arguments can be used in favour of prohibition." In our retrospect this is a most important point to make clear, because much of the opposition to the Convention, and much of the action of the British Government in 1907, was based on the imaginary grievance that our supplies of sugar were restricted by the action of the Convention in prohibiting the importation of Russian sugar which enjoyed a heavy bounty. A countervailing duty would have admitted the Russian sugar, just as the countervailing duty in the United States admitted hundreds of thousands of tons of German and Austrian sugar, to the great benefit of the American revenue and with no injury to the American consumer. It was the British free trader who insisted on prohibition—and then cried out, erroneously as it turned out, that the supply of sugar was being restricted.

We pass on to the one weak point in the terms of the Convention. The energies of the delegates at the Conference were naturally concentrated on the fight against the new cartel bounties in Germany and Austria which were ruining not only outside competition, but even the competition of the bounty-giving States who sat round the table. The method of dealing with this new attack—one which we shall hear more of in the future—was evidently to limit the amount of the surtax, that is, the difference between the Excise duty and the Import duty, to a figure which would not admit of the successful operation of a cartel. In the natural anxiety to arrive at a successful agreement this reduction of the surtax did not go far enough. The British delegates were warned that the surtax about to be adopted would still admit of the creation of a cartel bounty, but their anxiety for victory was too strong for them, and they agreed to the compromise. *The International Sugar Journal* has, from time to time since then, pointed out the progress of the new Austrian cartel, and given the exact figures of the new Austrian cartel bounty arising from the present legal surtax.

The only other important flaw in the Convention was the sudden and most gratuitous declaration of the British delegates, apropos of nothing, not asked for by anyone, and received with smiles, that Great Britain would on no account dream of giving preference to sugar produced in her own colonies; and they undertook, there and then, to have their undertaking put on record in the Convention. Our sugar-producing colonies were surprised, because they had been given to understand—erroneously, of course—that no such thing would occur. In 1914, when the war broke out, the British Government—a most curious inversion of their virtuous promise to give no preference to their colonies—actually ordered our sugar-producing colony of Mauritius to supply the British market with sugar below the market price of the world, and much below the price which Mauritius was obtaining in the Indian market. Such are the vagaries of economic science as professed by the sham free trader. Mauritius is a sugar-producing country which, in spite of many cruel set-backs, has always kept pace to a certain extent with the scientific progress of the industry and has, for many years, been producing a good class of white sugar direct from the cane juice, for which it gets good prices in the Indian market. The British Government wanted to get this sugar at a low price for the benefit of their dear friends the confectioners.

But let us return to our history of the Convention. The first article of the Convention declares that the contracting parties undertake to suppress direct and indirect bounties on the production or exportation of sugar, and proceeds to define, as follows, some instances of the way in which such advantages may result from State legislation :—

(*a*) Direct bounties granted to exports.
(*b*) Direct bounties granted to production.
(*c*) Total or partial exemption from taxation granted for a part of the manufactured product.
(*d*) Advantages derived from excess of yield.
(*e*) Advantages derived from the exaggeration of the drawback.
(*f*) Advantages derived from any surtax in excess of the rate fixed by Article III.

Definition (*f*), inserted at the instance of the British delegates, was absolutely essential in order to meet the case of the cartel bounties. They proposed to define cartel bounties as "advantages derived from any surtax," but, in view of the critical state of the negotiations, accepted the limitation. The first article is therefore so far inconsistent that, though it declares the abolition of all bounties, it permits any cartel bounty which may be obtained from the reduced surtax fixed by Article III. The figure of this surtax was, of course, a great bone of contention, but was finally fixed at six francs per 100 kilogrammes, that is, 2s. 6d. per cwt.

The direct bounties in Germany, France, Austria, and Holland came under definitions (*a*) and (*b*). The bounties defined under (*c*), (*d*), and (*e*) belong to one family, and are practically interdependent. Levying the duty on an estimated yield is probably followed by the obtaining of a yield in excess of the estimate, and consequently by "a total or partial exemption from taxation for a part of the manufactured product." But this would not necessarily create a bounty unless the full amount of duty were returned in drawback on export. In that case the manufacturer can obtain the full duty from the home consumer; but if it were not so, the exemption from taxation would merely operate as a reduction of duty to the consumer. Where the full drawback is returned on export, though the full duty has not been paid by the manufacturer, the drawback becomes an "exaggerated" one and the bounty is really the result of a combination of the cases defined in (*c*), (*d*), and (*e*).

The second article abolishes such bounties as these by prescribing excise supervision of factories and refineries, so that no duty shall be charged on the estimated yield, and therefore no drawback paid on exported sugar. Drawbacks will thus be abolished and the sugar for home consumption will pay the duty when delivered for that destination.

The third article fixes the maximum surtax.

The fourth article is the penal clause, the object of which is to give the contracting States security that they shall not in future have to compete with bounty-fed sugar.

These are the salient points of the Convention: the decision to abolish all bounties; the establishing of manufacturing and refining "in bond"; the limitation of the surtax; and the security to the contracting Powers that bounty-fed sugar will no longer be tolerated in their respective territories.

In our next article we shall show how those who opposed the abolition of the bounties, when they came into power, in 1906, absolutely ignored the solemn guarantee entered into by their predecessors, a guarantee without which the foreign Governments would never have undertaken the abolition of their bounties. The foreign Governments abolished their bounties with every confidence in the good faith of the British Government—they suddenly found that that confidence was misplaced.[1]

G. M.

---

[1] Since this article was in the hands of the printer the *Journal des Fabricants de Sucre* of 24th October has appeared, containing two important articles, one by the Editor on the denunciation of the Convention, and the other, an article by M. YVES GUYOT from the *Journal des Economistes* (15th September, 1917), entitled, "The Sugar Question in 1917." We shall have occasion to refer to these in our concluding article on this subject in the December number.—G. M.

Bagasse Furnaces.

A Brief Study in essential Points of Design.

By FRANK COXON.

Bagasse furnaces, like other equipment of the factory, have undergone many changes in design; yet there are few stations in the sugar factory that can compare with them as regards the manner in which such changes have been made, showing as they do complete opposites in their features, whilst, in many cases, almost equal results accrue. This is partly accounted for by the ignorance prevailing at one time of the principles of combustion of low-grade fuels, and partly by the absence of means to transmit successfully to the few receptive quarters, the valuable experience gained by the more progressive engineers who had the energy to study the questions carefully, with ability and power to carry out the requisite improvements.

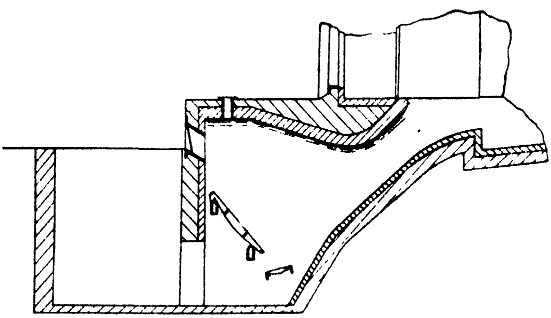


Fig. 1.

One of the first considerations for the smooth running of the factory is generally accepted to be a regular supply of cane, yet equally as important is the regular supply of steam, for when this latter runs out, the consequences immediately assume a ratio towards one another analogous to that in the story of "the house that Jack built."

There are four main conditions to be fulfilled if the maximum is to be obtained from the boiler house—

(1) Complete combustion.
(2) Minimization of radiation losses.
(3) Prevention of air leakage.
(4) Regulation of air.

And it is desired to show here the various methods and ideas adopted to fulfil the first condition, incidentally producing a progressive increase of efficiency in the others.

The diagrams reproduced here are representative of furnaces from actual practice and approximately one period; and being to scale, a study in turn will at once reveal how each engineer or designer considered he had overcome the difficulties experienced.

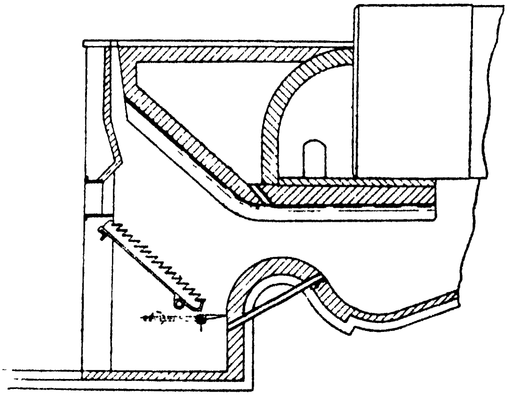


Fig. 2.

Fig. *1* shows a very common form of furnace, and unquestionably the main troubles encountered are low furnace temperature and incomplete combustion.

Fig. 2 shows two ways adopted to overcome these; first, extra or excess air is allowed to enter the furnace just pass the check wall with the idea of supplying oxygen to the distilled-off gases which have escaped complete combustion. This air, it will be noticed, is taken from the ashpit and also from the thin walls surrounding the furnace, both sources tending to impart an increase in temperature to this air supply. The practice, however, of taking air from the outer walls of the furnace and thereby cooling them is now abandoned by many, the value of incandescent brickwork being more thoroughly understood.

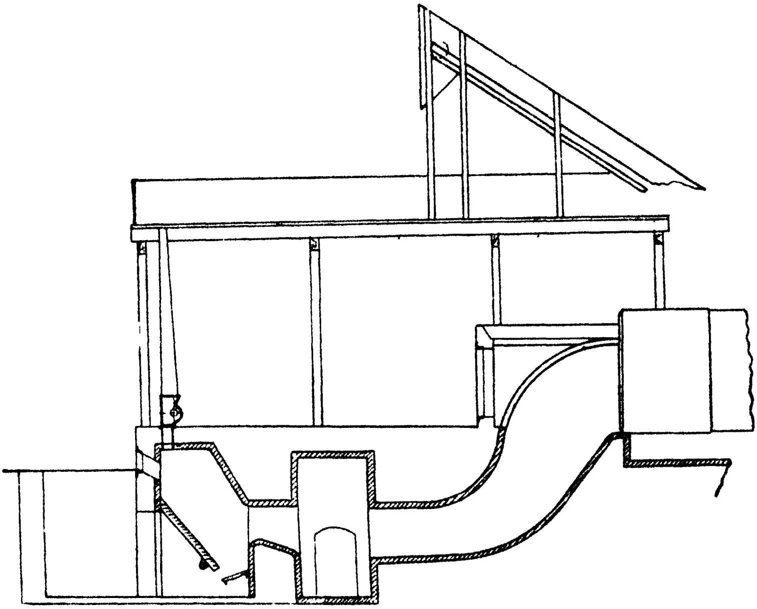


FIG. 3.

Secondly, a chamber is provided where the gases have an opportunity to expand after leaving the narrow throat and a tendency to reverberate, the highly heated brickwork together with this rolling action producing as near as possible complete combustion.

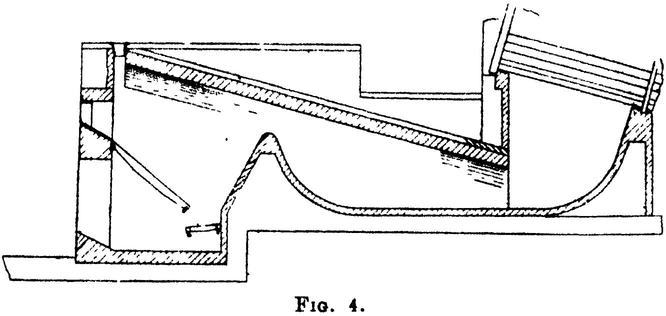


FIG. 4.

Fig. 3 shows how clearly the troubles from incomplete combustion were understood, and this extraordinary arrangement had three main objects for accomplishment—complete combustion, dry bagasse, and easy fire control, since the enormous amount of hot brickwork at once took care of the gases distilled off when low furnace temperature occurred at periods. The overall efficiency for such a design with a poor grade fuel may be indisputable, but for modern milled bagasse it is doubtful whether such would be the case on account of the heavy radiation losses.

Fig. *4* is quite a common form of furnace, demonstrating the advantages to be gained by the use of a combustion chamber and the passing of the gases over highly heated brickwork, in this case the long sloping arched roof. A further feature in design is the tapering throat compelling the gases to pass through at a high velocity immediately expanding in the combustion chamber and thus reducing dust entrainment to some degree. Such practice as this latter, however, calls for extra chimney draft and has a doubtful value.

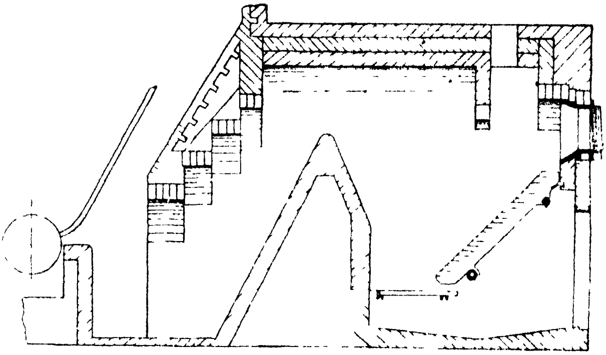


Fig. 5. Elevation.

Fig. *5*, a furnace doing excellent work, has two objects in addition to those already mentioned, one being radiation prevention, and the other, the regulation of the thickness of the fuel bed. It will be noticed that in addition to three thicknesses of 9-in. walls, an air space is provided between the outer two thicknesses, and such a design if carefully built yields the maximum in furnace efficiency. The hanging arch or curtain just in front of the fuel inlet has a tendency to regulate the thickness of fuel bed as well as prevent any flashing back of the flames on the feeding inlet; this feature being more fully developed, however, in some designs given later.

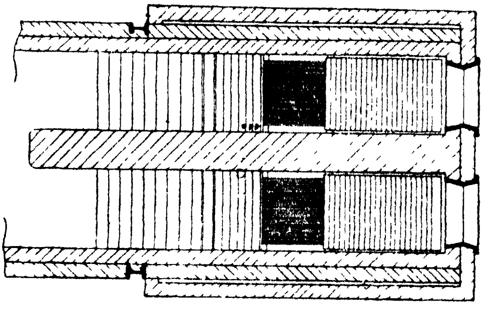


Fig. 6. Plan.

Fig. *6* is known as the Burt furnace, a forced draft design which has yielded excellent results in the past on bagasse of high moisture content. It is eminently suitable for deep fires and taking extraneous fuel in the manner of logs, etc., where such have to be used, having a record of being able to burn anything.

Fig. *7* is another type of flat-bar grate demonstrating the value of an even and as far as possible automatic feed. The fuel bed, it will be noticed, is of pyramid shape, although this is not what is known as the pyramid furnace, and is kept up by the specially shaped feeding spout which feeds in only sufficient to replace that burnt and works automatically. This design has been successfully worked, but is generally now being abandoned for more modern ideas.

Fig. *8* shows a remarkable change by evolution. This furnace is exclusively used in Java and Hawaii, the leading countries in the production of dry bagasse. First is noticed the complete absence of any definite combustion chamber, and, secondly, the attempt made to throw back over the fuel bed all the hottest gases generated by the lower part of the fire.

It is now well-established practice that this throwing back of the hottest gases gives a more thorough mixing of the products of combustion and eliminates the troubles experienced when the gases and air are allowed to get away in parallel streams, as in Fig. *1*. The returning arch forms part of the main setting but can be seen more clearly in Fig. *10*, whilst its complete absence and utility will be obvious upon reference to Fig. *1*.

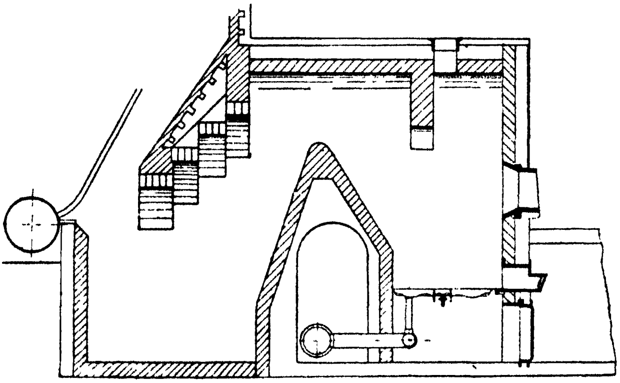


Fig. 6.

Another important feature is the development of the arch or curtain wall over the feed inlet. Here it will be noticed that the fuel slides down a neck of brickwork having a flat firebrick bottom, and arched top of tapering section which produces a conditioning effect on the fuel before reaching the burning zone, thus regulating the thickness of the fuel bed. The shape of the throat leading from the furnace to the boiler flues is of interest, containing a square or right-angled inset on the upper surface. This will have a tendency to produce a reverberatory motion to the gases and excess air, ensuring a better mixing of any unburnt products escaping from the furnace proper.

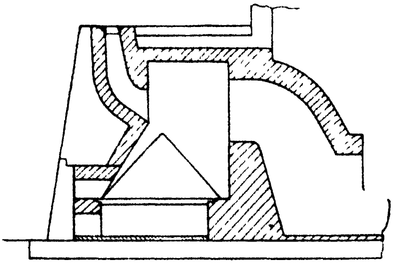


Fig. 7.

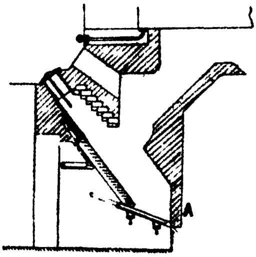


Fig. 8.

Such a furnace would only be successful when burning bagasse of as low a water content as 45 per cent. and under, complete failure resulting on fuels over this content unless they are very coarse. The extremely short distance from the fuel to boiler allows no space in which to rectify the incompleteness of combustion, consequently only dry fuel which yields short flames can be satisfactorily burnt.

Another noticeable feature that may be mentioned here, but is dealt with more fully later, is the absence of the usual air space between the bottom of the fire-bars and ash grate. The ash bars, it will be noticed, completely close up here, clinkering being accomplished by pulling up the ash bars, which are arranged in suitable sections for easy removal by sliding. This design is practically that adopted by the Java Experimental Station. Many of them are to be found with access arranged at *A*, and a tunnel built to take the clinker away from this side.

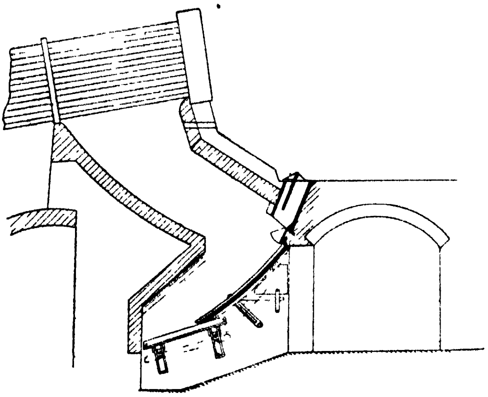


FIG. 9.

Fig. *9* illustrates a type of furnace designed to give varying angles of grate, thus regulating the depth of fuel bed and the consequential cubic capacity of the furnace to deal with various qualities of fuel.

The clinkering removable ash bar is also noticed here, but a more important feature is the right-angle flow of the products of combustion. Whereas in Fig. *8* the fuel bed and throat form a *T*, in the furnace now under consideration they form a right angle and thus compel the hot gases from the lower burning zone to travel right over the entering fuel. Entrainment is prevented by reason of the throat being continued up at an angle and by the absence of a combustion chamber, or similiar devised place at a level lower than the throat. Trouble may be experienced in certain cases where poor draft occurs through the flames being forced up into the feeding hopper.

Fig. *10* shows an American furnace of the forced draft type, which recognizes the point that hot brickwork being swept by the gases is an essential of first-class combustion efficiency. In this case the lower part of the combustion chamber is specially shaped to direct the gases. The type has serious disadvantages in that dust entrainment may close up the chamber to a considerable extent, and it is doubtful whether a square bottom of liberal depth would not give equal results.

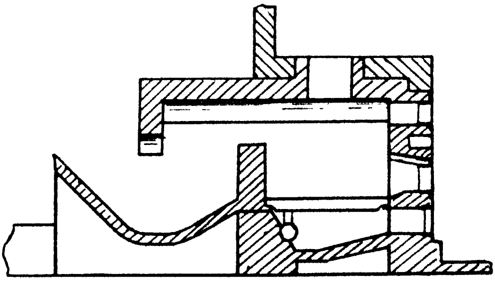


FIG 10.

Fig. *11* is representative of a good all-round furnace design embodying most of the most desirable features. Three points of interest require mentioning, however: first, the doubt in the designer's mind regarding the utility of the moving ash bars, as mentioned in the foregoing; secondly, the large area allowed for accumulation of dust in the combustion chamber, a point mentioned later; and thirdly, the path of the gases, which it will be noticed have now a Z shape to traverse. In this latter respect advantage has been taken of the hottest gases being doubled back by the arch; they are then made to traverse past the long sloping arch, and finally get mixed in the combustion space.

Fig. *12* is a modification of Fig. *8*, but much inferior in efficiency. Although the gases are thrown back somewhat, there is still a possibility of large volumes getting away in parallel lines to the boiler and being incompletely combust. For good quality bagasse of low water content fair results could be expected by reason of the contour of the roof. But the interposing of a chamber where advantage could be taken of the radiant heat would make this design more satisfactory.

Summary.—In reviewing the foregoing designs and many others to be found, not shown here, the writer suggests that for poor fuel the flat grate with high crown similar to Fig. *6* will give excellent results.

For fuel of 45 to 50 per cent. water content Fig. *11* can be taken as the best design, whilst better qualities can be satisfactorily burnt in furnaces similar to Figs. *8* or *12*.

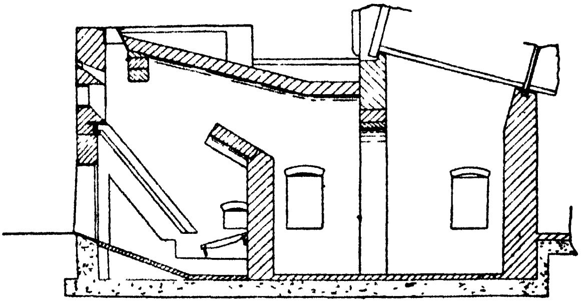


Fig. 11.

The necessity for combustion chambers or extra walls presenting highly incandescent surfaces to the furnace gases before being delivered to the boiler cannot be too freely mentioned in combination with the use of a doubling back arch.

Care should be taken also to see that the gases do not impinge directly on to brickwork once they reach their highest temperature, that is in the combustion chamber. A considerable amount of heat is wasted by presenting a direct right-angle or Z path to these gases which impinge on the corners and give out the major portion of their heat to be radiated away through either the ground or atmosphere.

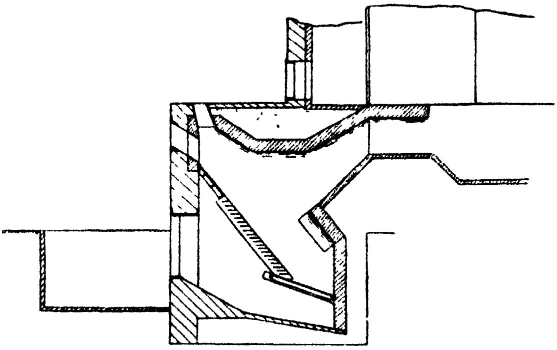


Fig 12.

The advantage of the great depth of combustion chamber in Fig. *11* will be very noticeable in this respect, likewise of that in Fig. *6*.

Radiation losses.—The losses from radiation are often estimated at as high an average as 10 per cent. of the total heat available, yet very little is done with respect to their reduction. Not only would this 10 per cent. be reduced but conditions generally would be very much improved by the transference of this heat to the gases, so as to yield higher furnace temperatures.

Only two of many cases that have come under the writer's notice show distinct ideas with regard to this. One is the building of a further 9 in. wall outside the usual 18 in. wall and allowing a dead air space between, some 2 to 3 in. in thickness, as shown in Fig. *5*.

This practice has its advantages and also objections, the chief of the latter being that the condition of the main walls cannot easily be ascertained by inspection. The adoption of this idea has however in the case of one type of boiler brought in considerable business; here the successful work in the boiler-house has been attributed to the boiler itself, but quite erroneously so, since it is the furnace which has proved its efficiency.

Thick walls of a greater depth than 18 in. are rare, yet the heat radiating from the surface is at once apparent and various means have been adopted to conserve this heat rather than to use thicker walls. The two most notable are painting with a mixture of tar and ashes, and the casing in of the brickwork with sheet steel and asbestos lining.

Steel casings, at one time considered a luxury, are now being seriously employed and are likely to become a usual feature of good boiler-house equipment, once the novelty has worn off. It might be suggested, however, that the boilers already fitted with this protection could have had the cost more advantageously laid out in better and more efficient furnace design, yet the conservation of this heat to the better working through higher furnace temperatures may have more than proved its value.

Air leakage.—Air leakage is now accepted as one of the causes of the most serious losses in poor furnace work. Cracks in the brickwork, badly fitting furnace ironwork and doors, plate dampers with their large slots, uneven feeding and absence of good control, all tend to allow excess air to enter the setting at one point or another and so bring down the effective work done as well as having a chilling effect on the furnace.

It is remarkable when going over a setting, to find the numerous points where heavy infiltration of air occurs, and when everything has been done to minimize the leakage to the lowest possible degree to note how sensitive the regulation and control of the fire becomes.

The use of the steel casings mentioned in the foregoing has for its dual object the prevention of air leakage and radiation losses.

Air regulation.—Given good conditions regarding air leakage, simple damper regulation or fire-bar manipulation becomes a very sensitive and easy operation, the use of ash-pit door control being rendered obsolete.

In conclusion, it may be said that no attempt has been made to deal with the proportions of the furnaces, grate areas, and fire bar design ; what was intended and hoped to accomplish was a short description of the many styles of furnaces found in practice showing the various stages of evolution undergone in the adoption of the various features now considered modern practice.

It is reported that seven thousand sacks of Russian sugar beet seed, valued at more than $200,000, have reached California *via* Vancouver; they came from the Black Sea district.

The longest drought experienced in the Hawaiian Islands for 48 years was still unbroken in the middle of September, and was seriously delaying the grinding work on some of the plantations. Even the ordinarily rainy districts on the windward side of Hawaii are affected, and in Maui the prospects for next year's crops are threatened.

The scarcity of sugar temporarily ruling in the United States is shown by the report that under an arrangement with the British Commission, 23,000 tons of sugar stored in New York awaiting shipment have been allowed to go on the American market in order to relieve the scarcity in the eastern part of the United States. The consignment is to be replaced when the new crop of sugar arrives.

The Economic Limit of Saturation.

By NÖEL DEERR.

A number of years ago I published an article on this subject; since then I have developed the idea in a much simpler form, as the following will show.

Let there be unit quantity of juice in a bagasse so treated that there is an exact balance between the steam afforded by the bagasse and the needs of the factory; to this bagasse let w water be added, and let the bagasse be again crushed to its original content of water; then $\frac{w}{1 + w}$ parts of the original juice is obtained. If $\frac{w}{2}$ water be added in two successive operations $\frac{4w + w^2}{(2 + w)^2}$ parts of juice are extracted, and if a system of single compound saturation be used with all the water added in front of the last mill, and the dilute juice returned to the penultimate mill, we obtain by the use of w water $\frac{w + w^2}{1 + w + w^2}$ parts of the original juice. (The development of the formulae to obtain these results is given in a preceding article.)[1]

Let the juice contain s sugar of which p per cent. is recovered in the subsequent operations; let the value of sugar be v, and let the efficiency of the added water be e; denote any one of the above expressions by F, and then the value of the sugar bagged is $spveF$ or, shortly, aF where $a = spve$.

The expense to be charged against this is the cost of evaporating the added water, w, in which is to be included not only the cost of fuel, but interest on capital required for larger heating surface, etc.; these expenses may not unreasonably be considered as a lineal function of w. Hence the profits of saturation are given by the expression $aF - bw$, where b is the cost of evaporating a unit of water; the economic limit will be reached when $aF - bw$ is a maximum.

Before going any further, some actual values may be given to s, p, v, and e. The extreme values of s may be taken as 10 per cent. and 16 per cent., of p as 70 per cent. to 85 per cent., of v as from $30 to $60 per ton, and e will be taken as 50 per cent. The lowest value of $spve$ will then be $0{\cdot}10 \times 0{\cdot}70 \times 30 \times 0{\cdot}50 =$ $1.05, and its highest will be $0{\cdot}16 \times 0{\cdot}85 \times 60 \times 0{\cdot}50 =$ $4.08. These values are expressed per ton of juice in the bagasse.

The cost of coal or its equivalent in other fuel at the furnace mouth will lie between $5 and $15 per ton, and allowing 8 lbs. of steam per lb. of coal and quadruple effect evaporation, a cost of 10 cents to 30 cents per ton of added water is found. In the case, then, of single saturation with the lowest values of s, p, and v, and the highest value of coal, the economic limit will be found by determining for what value of w the expression $1{\cdot}05 \times \frac{w}{1 + w} - 0{\cdot}3\,w$ is a maximum; in the case of compound saturation, the highest values of s, v, and p, and the cheapest coal, the economic limit will be found by determining for what value of w the expression $4{\cdot}08 \times \frac{w + w^2}{1 + w + w^2} - 0{\cdot}1\,w$ reaches a maximum.

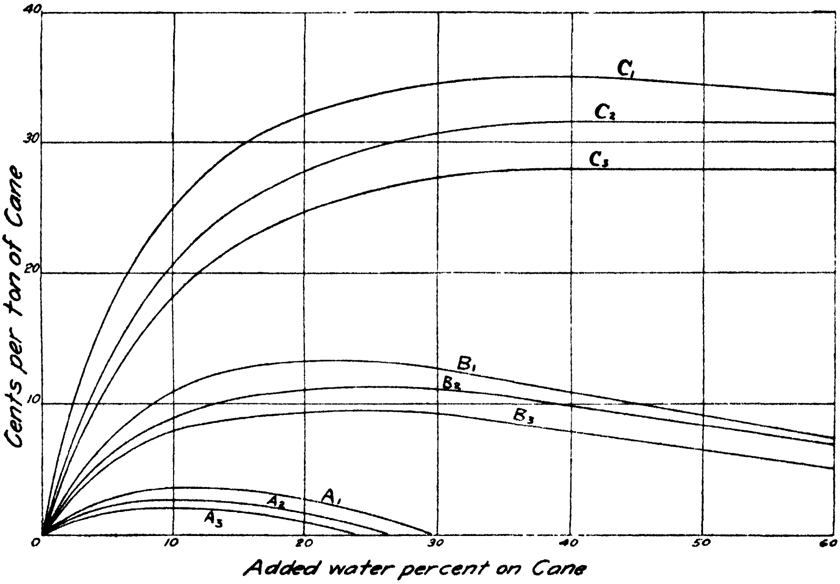
These problems can be solved by the use of the calculus, but a much better representation is given by the use of graphs, and nine such are given here:

---

[1] *I.S.J.*, September, 1917, page 401.

A_1, B_1, and C_1 are the graphs of the expressions
$$4 \times \frac{w}{1+w} - 0{\cdot}1\,w,\ 4 \times \frac{w+w^2}{(2+w)^2} - 0{\cdot}1\,w, \text{ and } 4 \times \frac{w+w^2}{1+w+w^2} - 0{\cdot}1\,w$$
respectively, and are intended to represent the most favourable conditions. A_2, B_2, and C_2 are the graphs of $2 \times \frac{w}{1+w} - 0{\cdot}2\,w$, of $2 \times \frac{w+w^2}{(2+w)^2} - 0{\cdot}2\,w$, and of $2 \times \frac{w+w^2}{1+w+w^2} - 0{\cdot}2\,w$, and are meant to represent average conditions. A_3, B_3, and C_3 are the graphs of $\frac{w}{1+w} - 0{\cdot}3\,w$, of $\frac{w+w^2}{(2+w)^2} - 0{\cdot}3\,w$, and of $\frac{w+w^2}{1+w+w^2} - 0{\cdot}3\,w$, and are designed to represent unfavourable conditions.

The abscissae in the graphs represent values of w expressed as added water per cent. on cane and the ordinates represent the profits due to the added water as cents per ton of cane. In making the calculation in order to avoid excessive



figuring the cane was taken as having 10 per cent. of fibre and the bagasse 50 per cent. of fibre, so that from 100 tons of cane there result 20 tons of bagasse and 10 tons of original juice; further, it is also assumed that the factory is balanced as regards extra fuel when dry crushing is practised, so that all the added water has to be evaporated with extra fuel.

Inspection of the graphs shows how variant must be the policy pursued by the factory executive to obtain the maximum profit. In extreme cases the addition of water may barely pay, in others as much as 40 per cent. may be advantageously used. It is also especially to be noted that all the graphs have a "flat" and not a "peaked" maximum, that is to say there is a region over which the maximum profits are sensibly constant with considerable variation in the quantity of water added, and it should not be without the limits of technical skill in combination with executive ability to determine in each case where this region lies with regard to the machinery as it exists in any one factory and with reference to the value of sugar and the cost of fuel. Difficulties which arise, and which are very hard to treat of are:—

1. It is difficult to determine the exact point at which the use of extra fuel becomes necessary.

2. The use of extra fuel is a function not only of the added water but is also controlled by the quantity of cane supplied in relation to the capacity of the factory.

3. A quantity of water indicated as economical at the time of operating may be the reverse when the sugar comes to be sold, and with a rise in the price of sugar the opposite may happen.

Notes on American Sugar Production.

From our American Correspondent.

The past two months have seen the machinery of food administration set up and put into working order over here. Sugar has received a good share of attention, and the plans for handling the sugar situation have been worked out with more completeness than those referring to any other commodity except possibly wheat.

It was about the middle of August that HERBERT HOOVER received his appointment as Food Administrator. One of his first acts was to create a Sugar Bureau, and to appoint as its Director GEORGE M. ROLPH, General Manager of the California and Hawaiian Sugar Refining Company of San Francisco, a sugar man of broad experience both in production and in refining. In the brief space of time that has elapsed since then, Messrs. HOOVER and ROLPH have made more epoch-making events happen in the sugar industry than ever before took place within the same length of time.

When Mr. HOOVER took his new post the price of sugar was advancing rapidly in this market. It had become evident that the Cuban crop would amount to little, if anything, above 3,000,000 tons, and that only about 200,000 tons of this remained unsold, leaving a theoretical shortage of nearly 200,000 for the requirements of the American market from that time to the end of the year, when new crop cane sugars would be available in quantity. The refiners had large export orders on their books; the neutral nations were clamouring for sugar, and the prospect pointed to a very great appreciation of prices under these conditions.

Mr. HOOVER attacked this situation with promptness and decision. His first step was to ask the suspension of future trading on the New York Sugar Exchange in order to forestall the possibility of an inflation of prices through speculative activities. The officers of the Exchange promptly complied with this request and future dealings came to an end on August 16th, probably for the period of the war.

The next act was the formation of a committee whose members agreed to find sugar to meet the needs of the American Army and Navy in such quantities and at such prices as the Government might decide. Through the work of this committee, beet sugar grown in California is now going to France to supply American troops there, the first time in the history of this industry that its product has been shipped outside the country.

A conference of beet sugar producers was called at Washington at which the representatives of this industry agreed to market this year's crop on the basis of 7·25 cents a lb. at seaboard points and at this price plus freight charges at interior points. This represented a voluntary reduction of a cent and three-quarters a lb. below the top price at which sugar had been selling. Moreover, the beet sugar men undertook to supply the sugar requirements of the entire country west of Chicago and St. Louis during the remainder of the year. A committee on distribution has been appointed to see that this sugar is equitably distributed and to pro-rate freight charges among the various producers.

At the present time, therefore, the anomaly is presented of two distinct price levels for sugar, one of 7·25 cents for beet sugar and Hawaiian cane in the Western States, and one of 8·35 cents for Cuban cane along the Atlantic seaboard.

A similar agreement has been made with the refiners limiting the margin on which they operate, and it is expected that Cuban producers will join in this movement and will accept a base price of 4·50 cents or thereabouts for 96° test sugar in Cuba.

One effective step has been the elimination of competition between the United States and its Allies in the purchase of sugar through the creation of an International Sugar Commission, which is to do all the buying of foreign-grown sugar. The two British members of this Commission, Sir JOSEPH WHITE TODD and JOHN RAMSEY DRAKE, are expected to arrive here within the next few days to take up their duties. This co-operative action, together with the embargoing of sugar exports, will place the United States and its Allies in a commanding position to obtain adequate supplies of sugar to meet all ordinary requirements during the coming year. Already, out of the scanty supply available, arrangements have been made to send an additional 100,000 tons to France.

This very satisfactory handling of what threatened to be a serious situation has been made possible by the voluntary action of American sugar producers in agreeing to limit prices and to co-operate with the Food Administration in the distribution of their crop. It should result in a very great saving to consumers on both sides of the Atlantic and prevent any further serious shortage during the coming year, providing adequate transportation facilities can be made available.

New York, October 18th.

The "Norit" Process of Refining as applied to a Beet Sugar Factory.

By W. HUGH GIFFARD.

Owing to the war the Dutch sugar refiners in Amsterdam are unable to import raw sugar, so the Dutch Government only allows a certain percentage of raw sugar to be refined in the beet sugar factories. Consequently at the end of the 1916-1917 campaign only the percentage of raw sugar allowed by the Government was converted into refined white sugar. The balance was made into white non-refined sugar; and at two of the factories the Norit Process was installed and operated with success. The following is a description of the *modus operandi* employed at one of these establishments.

Raw sugar is emptied into a tank where it is stirred and mixed with syrup from centrifugal *A*.[1] In this tank "blue" is added, a solution of "blue" being made by dissolving 100 grms. of "blue" in 10 litres of water, and 5 litres of this solution are used to every 20 sacks of raw sugar (each sack weighs 100 kg.). It is mixed for about ten minutes and then goes straight down to centrifugal *A*. The sugar is washed with steam in the centrifugal and then carried to coolers, from whence it is conveyed to a sort of winnowing machine which separates the lumps from the sugar. Thus only one quality is produced, i.e., unrefined sugar.

---

[1] Centrifugals *A*, *B*, and *C*, denote respectively the centrifugals for first, second, and third product sugar.

Next the syrup from centrifugal *A* is pumped to tanks from whence it is drawn as required for the second product vacuum pans. The massecuite from these pans goes through the usual process until it leaves the centrifugal *B* as second product sugar and syrup. The syrup is cooked in vacuum pans and from the centrifugal *C* is produced molasses and third product sugar.

The second and third product sugars are dissolved in water and led away to strainers where the sugar sweepings and lumps from all the three product sugars are melted down and strained. This solution of sugar is then run straight to the Norit tanks. Here it is necessary to leave the sugar and explain the preparation of the Norit.

There are in all seven tanks, *A*, *B*, *C*, *D*, *E*, *F*, and *G*.

Tank *D*, or the Norit preparation tank, is a round one with an opening on the top connected to a trough in which there is a worm gearing to bring along the Norit solution. There is also on the top an observation man-hole. A pipe with a valve supplies the cold water with which the Norit is mixed. A shaft, to which are attached several arms, stirs the mixture. At the bottom is an outlet pipe connected to a pump in order to feed the tanks into which the sugar solution is run. Tanks *E* and *F*, called the soda tanks, are similarly constructed, but have a copper coil of piping through which steam is passed. Instead of a pipe leading away at the bottom to the sugar tanks, there is one leading to a pump which pumps the Norit "solution" to filter-presses No. 1.[1]

Tank *G* (or the hydrochloric acid tank) is made of wood and has exactly the same fittings as tanks *E* and *F*.

The tanks *A*, *B*, and *C* (or juice tanks), where the Norit "solution" is mixed with the juice, are constructed as follows:—

They are also round tanks with a revolving shaft down the centre, to which arms are attached in order to stir the solution. A copper coil through which the steam passes runs round on the inside. At the bottom is an outlet connected to a branch pipe, one part of which carries the juice away from the tank, and the other part brings it to the tank from the strainers. At the top is a pipe from the Norit pump beyond tank *D*, and an observation man-hole. At the side there is a tap for taking samples. Their capacity is about 40 hectolitres each. To all these tanks, *A*, *B*, *C*, *D*, *E*, *F*, and *G*, there is an exhaust pipe to carry the steam and other gases outside the factory.

Some 80 kg. of fresh Norit to every 40 hectolitres of cold water is emptied into tank *D*. It is stirred for a short time and samples are taken in order to test the strength of the admixture. It should be of 25 per cent. strength, and 1 litre of the liquid should weigh 1086·4 grms. Three hectolitres of the liquid are necessary to every 40 hectolitres of sugar solution in tanks *A*, *B*, and *C*. These 3 hectolitres are pumped into tank *A*, *B*, or *C*, according as to which is then in use. The mixture is stirred for about 20 minutes and brought to a temperature of 90° C. It then has 2 or 3 litres of phosphoric acid added to it in order to keep it slightly acid. The solution of phosphoric acid is made by dissolving 50 kg. of superphosphate of lime in 3 to 4 hectolitres of water, and after boiling the whole is allowed to stand for about 12 hours. Then it is drawn off as required but always from the surface of the solution.

---

[1] Filter-presses No. 1 and No. 2 denote respectively filter-presses for the clean Norit and the juice.

The sugar and Norit mixture are pumped to filter-presses No. 2 where the juice is freed of the Norit. As the quantity of Norit (2 per cent. dry Norit) in the juice mixture is so small, it is only necessary to clean the filters about every 12 hours. The juice is then pumped away to ordinary filters.

After about 12 hours of use, clean water is pumped through the filter-presses No. 2 in the opposite direction until the water coming out only contains about 0·01 per cent. of sugar. This water is run to tank *B*, where it is treated in the usual way with Norit and is run into the juice.

It is then necessary to open out the filter-presses No. 2 and remove the deposited Norit from off the canvas filters. This sediment falls down into a trough fitted with a worm transporter gear and is carried to tanks *E* and *F* (soda tanks). Here it is treated with water, and 12 kg. of soda to each filter-press (about 600 kg. of Norit) is added. This solution is boiled for one hour and kept stirred all the time.

The object of adding this soda is to regenerate the used Norit by destroying the organic matter absorbed by the Norit from the sugar solution. The destroyed organic matter is soluble in the strong soda solutions used, and such solutions with the organic matter in them are removed from the Norit by filtering the mixture of Norit and soda, and by washing the Norit free of soda in the presses with hot water. So the contents of tanks *E* and *F* are pumped to filter-presses No. 1. As soon as the tanks are empty, the man-in-charge of the filter-presses knows that all the Norit has been deposited on the filter cloths, so he turns on the water which is run through for about four hours. This removes all impurities. The press is then opened and the Norit transferred to tank *D*.

Each time that filter-presses No. 1 are opened, a sample is taken and tested for ash; fresh Norit contains about 6 per cent. ash, and when in use it absorbs ash from the juice; so when the ash content has risen to 12 per cent., it is necessary to revivify the Norit.

So instead of it being run, after the juice next passes through it, to tanks *E* and *F*, it is run to tank *G* or the hydrochloric acid tank. The hydrochloric acid is of 27 per cent. solution, and about 20 litres per filter-press are added. It is boiled with the acid for about one hour, and afterwards pumped to filter-presses No. 1, where it is washed with pure water in the same way as for soda. From the filter-press No. 1 it is run into tank *D*. Fresh Norit is added as required to keep up the necessary quantity.

After the juice (which is very nearly colourless) has passed through the ordinary filters, it is run to tanks to await boiling in the vacuum pans. In these latter it takes about an hour to boil to string proof, and when that stage is reached a solution of "blue" (the same as previously used) is added. Three hours in all is usually enough time to produce a massecuite. This is then worked up and passed on to centrifugal *D* (a centrifugal used only for refined sugar), where it is washed with steam. The sugar is carried to coolers and then sieves, where three sorts of sugar are produced—coarse, middle, and fine. The lumps are dissolved as previously described. The syrup from the centrifugal *D* is used in the white sugar vacuum pans until too dark, and is then boiled with the second product sugar.

When this process is in thorough working order it is sometimes possible to reduce the 2 per cent. amount of dry Norit down to 1·8 per cent.

I cannot close this description without expressing my gratitude to Dr. FLECKE, of Dinteloord, North Brabant, for granting me facilities to study the process.

Stripping Sugar Cane by Hand before Planting.

By ARTHUR H. ROSENFELD.

Early in 1915 the writer published in this Journal[1] a description of a series of experiments made to determine whether or not it is beneficial to strip sugar cane by hand before planting it, and arrived at the conclusion that no benefit was obtained. It was pointed out in that article that the experiment was initiated on account of two distinct and theoretically well warranted opinions on the matter. On the one side it would appear that, given the parchment-like nature of a dry cane-leaf, it would be much easier for the young shoots to reach the surface of the ground if they did not have to find openings in this leaf sheath before going upwards. On the other hand, many cane men maintain a decided usefulness for the leaf covering as a preserver of moisture around the eye.

Although, as pointed out above, the plats planted with cane stripped by hand gave, both as plant cane and first-year ratoons, practically the same results as those planted with the usual plant cane of the country, it was resolved to start another series of the experiments in the Tucumán Sugar Experiment Station, planting them in 1914.

As regards method of plantation, cultivation, etc., they were essentially the same in this series as in the first series already described in the *International Sugar Journal.*[2] I am indebted to Dr. W. E. CROSS, the present Director of the Tucumán Sugar Experiment Station, for furnishing me with the data of the 1916 crop :—

TABLE OF YIELDS.

	Yield of Cane in kgs. per hectare.		
Year and Age of Cane	Unstripped Cane.		Stripped Cane.
	First Series.		
1912—Plant..	29,066	....	29,416
1913—First-year ratoon ..	47,104	....	46,286
	Second Series.		
1915—Plant..	15,333	....	17,600
1916—First-year ratoon ..	22,200	....	22,800
Average	28,426	....	29,026
Equal to per acre	25,310 lbs.	....	25,853 lbs.
	or 11·3 long tons	....	11·5 long tons

As will be seen from this table, the second series of experiments has shown a slight increase in yield for the cane stripped by hand before planting, but the yield is so small that it would hardly pay the expenses of stripping the cane by hand, and is certainly not sufficient to offer very much promise for this process. The average results of these four crops would lead us to the conclusion that there would be no commercial advantage in adopting this system—at least under Tucumán conditions.

---

[1] pp. 183-184. [2] *Ibid.*

Formulae expressing the Efficiency of Milling.[1]

By L. FOUQUEREAUX DE FROBERVILLE.

In place of comparing the working of the mill by Lely's formula, which, indeed, gives nothing very precise, I have tried to establish one indicating, not the ratio of the normal juice lost in the bagasse per 100 of fibre, as Lely's does, but the ratio between the normal juice lost in the bagasse per cent. of the total juice contained in the cane. As the result, I have established the following two formulae, which, though starting from different data, each give the same result:—

(1)

$$\frac{100 \times \text{sugar in bagasse, per cent. cane}}{\frac{\text{Sugar, per cent. dilute juice (weight)}}{100} \times \frac{\text{total pure juice in cane}}{100} \times (100 + \text{dilution, per cent. normal vesou})}$$

(2)

$$\frac{100 \times \text{sugar in bagasse, per cent. cane} \times \text{normal juice, per cent. cane}}{\text{sugar normal juice, per cent. cane } (100 - \text{fibre, per cent. cane})}$$

Using indifferently one or other of these formulae, I found that Factory No. 16 (Mutual Control No. 5, 1914 crop) was the one losing the least normal juice in the bagasse, namely, 6·62 per cent., whereas Factory No. 5 lost 11·6 per cent., as is shown in the table given below.

But all the factories in determining the sugar did not use the inversion method, and these would find the content of sugar in the cane to be lower. Hence, I have separated the two methods of control, and the figures obtained in each are given in the table:—

INVERSION.							DIRECT READING (Simple Polarization).						
Factory No.	Sugar, per cent. Cane	Fibre	Normal Juice, per cent Cane	Sugar in Bagasse, per cent Cane.	Loss	Lely Value	Factory No.	Sugar, per cent. Cane	Fibre	Normal Juice, per cent. Cane.	Sugar in Bagasse, per cent. Cane	Loss	Lely Value.
25	13·85	12·78	79·9	0·96	6·82	46·5	16	13·35	12·43	76·6	0·94	6·62	54·0
2	12·85	12·50	75·3	0·98	7·10	—	11	13·18	10·61	80·0	0·92	6·71	56·6
29	14·07	11·40	80·5	1·05	7·33	56·4	33	14·45	12·00	77·2	1·03	6·73	49·4
30	14·17	12·90	76·1	1·17	7·86	58·8	3	12·92	12·20	75·8	0·99	7·21	49·4
14	13·33	12·64	75·4	1·23	8·10	60·7	8	13·07	12·34	76·9	1·00	7·24	50·1
15	13·33	12·43	76·3	1·17	8·36	—	20	13·57	11·58	78·8	1·04	7·39	55·4
13	13·31	11·50	79·6	1·14	8·42	65·0	9	13·09	12·12	75·5	1·05	7·49	56·6
6	12·99	11·69	77·8	1·15	8·56	—	21	13·65	11·88	78·8	1·06	7·53	55·5
17	13·43	12·22	76·2	1·21	8·59	61·4	27	13·88	11·71	77·5	1·12	7·70	61·8
28	13·93	11·44	78·0	1·24	8·60	64·7	7	13·06	11·75	77·1	1·06	7·71	58·2
1	12·73	12·49	73·8	1·22	8·93	69·3	22	13·73	11·85	78·5	1·11	7·83	57·5
31	14·25	12·12	74·3	1·38	9·06	67·3	24	13·85	10·51	79·1	1·19	8·30	70·6
23	13·83	12·99	75·1	1·32	9·10	58·9	12	13·23	11·25	75·3	1·26	8·93	69·3
18	13·43	13·54	73·3	1·44	10·18	64·9	4	12·96	12·13	75·6	1·23	9·02	—
32	14·34	10·78	76·2	1·62	10·88	—	19	13·57	12·50	74·7	1·30	9·04	—
26	13·87	11·57	76·2	1·63	11·47	87·2	10	13·10	11·91	76·1	1·30	9·43	—
34	14·97	11·35	77·1	1·67	10·92	80·4	5	12·96	12·61	73·6	1·62	11·60	—

According to the preceding figures, Factory No. 25 with a dilution per cent. normal vesou of 18·2 per cent. lost less normal juice in the bagasse with a cane richness of 13·85 than Factory No. 2 with 14 per cent. dilution and a cane richness of 12·85, and less still than Factory No. 29 with 22·2 per cent. dilution and 14·07 of sugar, per cent. cane.

---

[1] *Bulletin de la Société des Chimistes de Maurice*, 1917, 8, No. 33, 18-20.

By Lely's formula, Factory No. 28 did better than No. 13, and No. 1 better than No. 28; whereas from this formula, No. 13 with 17·8 dilution per cent. normal vesou, and 13·31 sugar per cent. cane, did better that No. 28 with 15·0 dilution per cent. normal vesou and 13·93 of sugar per cent. cane; and better still than No. 1 with 23·4 dilution per cent. normal vesou and 12·73 sugar per cent. cane.

Taking the two examples mentioned by Giraud,[1] and calculating the normal juice lost in the bagasse for Factory No. 7, I found 8·26 per cent., and for Factory No. 9, 10·04 per cent., indicating that Factory No. 7, though possessing mills inferior to Factory No. 9, crushed its canes better and lost less normal juice in its bagasse, whereas Lely's factor indicates that the two factories lost the same quantity of juice per cent. fibre.

Likewise, referring to the three analyses of cane,[2] variety No. 55 left less normal juice in the bagasse per 100 of total juice of the cane than DK 74 and Big Tanna; No. 55 lost 6·17 per cent., DK 74, 6·69 per cent., and the Big Tanna, 7·83 per cent., whereas Lely's formula gives the lowest loss to the one having the highest content in fibre—

	Big Tanna.	DK 74.	No. 55.
Fibre, per cent.	12·82 ..	10·12 ..	9·32
Loss in normal juice..	51·3 ..	58·7 ..	58·8

Experiments on the Manufacture of Decolorizing Carbon for the Manufacture of White Sugar.[3]

Experiments that have been carried out by a sectional chemical committee of the Royal Society, at least partially reveal the secrets of manufacturing the decolorizing carbon known as "Eponit." This product was discovered in Germany. It is stated that "Eponit," or whatever this special material may be called, is of great service in decolorizing sugar solutions and in the clarification of sugar syrups.

Reports have been made on the experiments conducted by the committee mentioned, which acted on behalf of the Royal Society. These stated that:—

The problem that we were originally asked to solve respecting "Eponit" was the identification of the wood from which it was made. Charcoals were therefore made in small quantity from a variety of woods, examined microscopically, and compared with "Eponit." We came to the conclusion that it was made from a mixture of coniferous wood such as pine or cedar, and angiospermous wood such as poplar or willow.

Charcoals made with various woods by carbonizing at a red heat proved to have little decolorizing power when tested with caramel solution.

We then extended our experiments by treating the wood with solutions of various substances before carbonization. These experiments were based on Ostrejko's patent,[4] which consists mainly in boiling the wood as sawdust or shavings with a solution of calcium or magnesium acetate; drying, adding lime or magnesia, carbonizing at a red heat, washing first with hydrochloric acid and then with water, drying, and again heating to redness. Charcoals made from pine and cedar wood by this process decolorized caramel solution better than those made from untreated wood.

---

[1] *Bulletin de la Société des Chimistes de Maurice*, No. 20, 97. [2] *Ibid.*

[3] From a Report made by the United States Consul, London.

[4] British Patent, No. 18040, of 1900.

As Ostrejko states that the addition of starch mucilage to the wood treated with calcium acetate increases the decolorizing power, charcoals were made from pine and cedar wood with this addition to the calcium acetate process. The decolorizing power was thereby increased, but subsequent comparison with "Eponit" showed that the latter substance was still superior.

During these and other experiments we came to the conclusion that the temperature we had employed was not sufficiently high. We then made charcoals from (*a*) a mixture of pine and willow wood with calcium acetate and starch, and (*b*) from cedar wood with calcium acetate, at a temperature approaching white heat. Both these charcoals tested with the caramel solutions gave filtrates which were absolutely colourless, while with "Eponit" the solution was a pale but distinct yellow.

In continuation of our experiments on "Eponit," we have made trials with willow wood and cedar wood as two distinct types of wood. Experiments made with each wood were: (1) With the natural wood, without any treatment; (2) with the wood treated with milk-of-lime; (3) with the wood treated with calcium acetate. In all these cases the carbonization was effected at a temperature approaching that of white heat, and the charcoal was washed first with hydrochloric acid and then with water, and finally again heated.

The results were: (1) Charcoal useless for decolorization purposes, (2) and (3) charcoals very active; all of them practically equal to "Eponit"; the calcium-acetate charcoals slightly more active than the milk-of-lime charcoals. Decolorizing tests were made with caramel solution at boiling temperature and also at laboratory temperature; in the latter case the "Eponit" was slightly less active than the charcoals of 2 and 3. The type of wood has little or no influence on the result, and probably any porous wood would give an active charcoal.

The process we have used is: Mix pine, willow, or cedar wood in sawdust with milk-of-lime to form a dough. Heat to drive off some of the water. Introduce the mass, while still damp, into a crucible, cover with a layer of lime, and raise in a suitable furnace to a temperature approaching that of white heat. Remove the crucible from the furnace, transfer the contents to water, add excess of hydrochloric acid, heat to boiling, filter, wash with hot water, drain, and heat in an iron retort to a red heat. Powder the charcoal and sift it through a 60 mesh sieve.

In one or two experiments the finest particles passed through the filter-paper; this can be obviated by sifting on a 90 mesh sieve and rejecting the powder that passes through, but the finest powder is a very active decolorizer.

The treatment with lime is more economical than that with calcium acetate, and the resulting charcoal is practically equal in decolorizing activity.

We used a No. 6 salamander crucible, heated in a Fletcher radial injection furnace, for the high-temperature experimental work. The process could be adapted for the preparation of larger quantities by using a suitable still of refractory material.

It is stated that an important discovery of potash deposits has been made in the neighbourhood of Solikamsk, Russia, opening up a wide field of possibilities from a commercial and agricultural point of view. Prof. KOURNAKOFF has established the fact that the soil in the region mentioned contains more than 20 per cent. of potash (K_2O), making the deposits among the richest in the world.

The Tucumán Sugar Experiment Station.

In the course of a communication we have received from Dr. W. E. Cross, of the Experiment Station, Tucumán, Argentina, this technologist, who it will be remembered succeeded Mr. A. H. Rosenfeld as Director of the Station, gives the following interesting account of the work of his department.

There never was a time in the history of the Tucumán Experiment Station when it stood stronger in the opinion of the local industry. During the last two or three years it has achieved a number of conspicuous successes, and it is these successes which have caused it to be regarded as indispensable to the Province. The latter has suffered terribly from a startling and rapid degeneration of the native cane, which was probably worse than any similar phenomenon known in the history of the world's cane industry. Fortunately when the climax came the work of the Station on the new varieties of cane imported from Java had reached a satisfactory conclusion. The station recommended the canes very strongly. The recommendations were accepted, and in the short space of two years there have been planted over 50,000 hectares (say 124,000 acres) with this kind of cane.

The other variety work of the station is attracting great attention. They have a number of other promising canes, which while they do not excel the Java canes have many valuable properties. This year they are importing varieties from foreign countries to an extent they have never done before. They have also had success, after many years of failure, in producing canes from seed, and the Province is very interested in the study of these Tucumán seedlings. They are extending this work very much, including the planting of a nursery in the Northern Provinces of the country, the investigations being financed by a special fund which was subscribed for by a number of prominent sugar men on their own initiative.

Among other work undertaken by the station which has already proved of value in the Province is that of testing methods of planting and harvesting the new Java canes, methods of cultivation from the point of view of the conservation of the moisture in the soil, and some very thorough experiments on irrigation.

As is known, the station now has four well-organized departments besides that of agriculture, viz., horticulture, chemistry, plant pathology and botany, and entomology; and each department is doing work which commands appreciation. The station is developing into a large consulting bureau, its advice being sought frequently on all phases of agricultural work. It is true that Tucumán is feeling the crisis brought about by the war and also by the successive bad harvests, but this is not affecting the station as much as it might have been expected to do. As a matter of fact they have this year erected a new greenhouse measuring 20 by 8 metres, with heating installation. Then, a number of sugar companies have paid the cane tax which supports the station some months before it was due, in order that the work should not be interfered with.

The work projected for the coming year is being watched with great interest by the Province, especially that concerning varieties and methods of planting and cultivation adapted to the dry conditions, such as we have experienced during the past three seasons.

The study of the sugar beet as a possible alternative crop for Tucumán, which the station has just started, has also aroused great interest.

The Curtis Bay Chemical Co., Baltimore, formerly large manufacturers of acetone, are turning their attention to the manufacture of potash and other products, such as acetates, using for this purpose the waste molasses of the Curtis Bay Distilling Co.

An Old Time Refiners' Advertisement.

We stated in our June issue that the history of sugar in the United States is largely a struggle between the refining and the producing interests, in which the former have always endeavoured to get the monopoly of all the sugar entering into the States; and that for many years the United States refiners boomed the *Acarus sacchari* or sugar louse for all it was worth as a conclusive illustration of the necessity for issuing nothing but refined sugar to the consumer. Since then we find given in a copy of the American *Congressional Record*, in the course of a speech by Senator BROUSSARD, the *ipsissima verba* of an old-time advertisement which the American refiners circulated in the press of their country *circa* 1898 to prejudice the public against unrefined sugars. It is worth repeating here as showing that Captain BATHURST's description, in the House of Commons, of the impurities found in certain imports into this country of raw sugars said to be from Cuba was anticipated twenty years ago in America. Some of the raw sugars of those days *may* have merited the description, but a large number of excellent plantation browns for which Louisiana was then famous were, if we understand aright, unjustly included in the stigma.

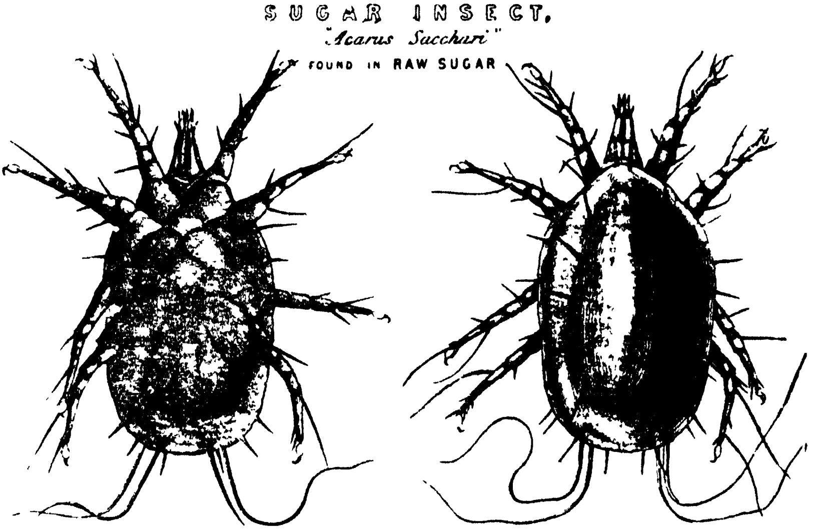


FIG. 1. FIG. 2.

WHAT ARE RAW SUGARS?

Professor CAMERON, public analyst of the city of Dublin,[1] who has examined samples of raw sugar, states that they contained great numbers of disgusting insects, which produce a disgusting disease. Their shape is very accurately shown in the accompanying figures magnified 200 diameters. Fig. 1 is the underside and Fig. 2 the upper side.[2] His description is as follows: The *Acarus sacchari* is a formidably organized, exceedingly lively, and decidedly ugly little animal. From its oval-shaped body stretches forth a proboscis terminating in a kind of scissors, with which it seizes upon its food. Its organs of locomotion consist of 8 legs, each jointed and finished at its extremity with a hook. In the sugar, its movements from one place to another are necessarily very slow, but when placed on a perfectly clean and dry surface, it moves along with great rapidity. The number of *Acari* found in raw sugar is sometimes exceedingly great, and in no instance is the article quite free from either the insects or their eggs. Muscovado as it comes from the colonies should never be used.

---

[1] Why American refiners should require to go to Dublin of all places for an opinion on this point is beyond one. Was there no prophet in Israel?—ED. *I.S.J.*

[2] The figures reproduced here are not taken from the advertisement quoted, but from an old number of the *Sugar Cane*; we believe, however, that it was the illustration in the latter which was reproduced in the advertisement.—ED. *I.S.J.*

The *Acari sacchari* do not occur in refined sugar of any quality because they can not pass through the charcoal filters, and because refined sugar does not contain any nitrogenous substance upon which they could feed.

Use only refined sugar.

No wonder then that, with this advertisement constantly before them, the American sugar consumers of that day had no stomach for raw sugars of any kind, and the astute refiners reaped the benefit of their advertising outlay.

The American Cane Sugar Industry.[1]

III. Cuba.

GENERAL.

Cuba, the largest island in the Caribbean Sea, is about 730 miles long; in breadth it varies from 160 miles in the eastern province of Oriente to 22 miles in that of Habana near the western end. The total area is 44,164 square miles [or about nine-tenths the size of England].

The island has a foundation of pre-tertiary sedimentary rocks. Above this are littoral beds composed of terrigenous material, and then a great thickness of white limestone, consisting of organically derived oceanic material. The island was reclaimed from the sea by a great mountain making movement in the late tertiary period, succeeding the deposition of this limestone. At the two extremes of the island there are well defined ranges of hills; those at the west end rise to an altitude of 2500 ft., while the surface of Oriente is broken with high sharp mountain ranges, broad plateaus of considerable elevation, and deep valleys, some of which are broad, while others are narrow and resemble canyons. There are many points exceeding 5000 ft., while the highest summit is 8322 ft.

The central provinces of Cuba consist mainly of broad rolling plains with shallow stream valleys. In Habana, Matanzas, and Santa Clara these plains were, prior to the war with Spain, in a high state of cultivation, while those in the province of Camaguey have been in the main used for cattle grazing. Much of the land in Pinar del Rio at the western end is given over to the production of tobacco, reputed to be the best in the world. The lands of Habana province produce sugar cane, tobacco, coffee, pine-apples, bananas, fruits, and vegetables of all kinds. In Oriente, the great plain forming the valley of Guantanamo is extremely fertile. Other great plains and fertile districts in this province are Manzanillo and Bayamo, the central plains extending from Nipe Bay to the border of Camaguey, and those in the vicinity of Banes. Although 300 years of cultivation has exterminated the forest in the sugar lands of the centre and west, it is estimated that in the hills of those districts and in the mountains of the east nearly 13,000,000 acres of uncleared forest remain. The principal sugar belt is the comparatively level strip of country extending almost round the island near the coast.

---

[1] Abstracted from "The Cane Sugar Industry", an inquiry into the agricultural, manufacturing, and marketing costs in Hawaii, Porto Rico, Louisiana, and Cuba, by the United States Bureau of Foreign and Domestic Commerce. Miscellaneous Series, No. 53, Department of Commerce, Washington. (See *I.S.J.*, 1917, 359; also 1917, 420, and 464).

The Cuban climate is tropical and distinctly insular in characteristics of humidity, equability, and high mean temperature. There are two distinct seasons, a dry one from November to April, and a hotter wet season from May to October. The average mean temperature is about 77°; temperatures above 90° or below 50° are rare. As a rule, the rainfall is least upon the seacoast and greatest in the interior, and there is little difference between the eastern and western parts of the island. It varies from an average of 45 inches on the south coast to 60 inches in the interior. The prevailing wind is the north-east trade wind. According to records in the possession of the agricultural experiment station there has never been, over a period of 49 years, a single year without a three months' drought, and during the 49 years more than half the rain has annually fallen in less than four months. For these reasons the sugar cane crop is produced almost entirely under natural conditions of rainfall.

According to F. S. Earle, Cuba has been greatly favoured as regards soils and topography. The other West India islands are mostly rough and mountainous, with only a narrow rim of level land next to the sea and extending in narrow valleys up the larger streams. Cuba, on the contrary, is a great plain rimmed at the eastern end with high mountains, but with only a few scattered chains and ridges in the central and western portions. A very large proportion will admit of cultivation of one kind or other, and probably considerably over three-fourths is sufficiently level and free from obstructions to admit of the use of all kinds of improved farm machinery. The soils of these great level expanses may be roughly divided into four classes: first, the red land, found mainly in Habana and Matanzas provinces; it is very sticky when wet and is heavy and difficult to cultivate, and yet it allows water to pass through it as readily as through the lightest sand; for this reason it suffers from drought, while irrigation is difficult to effect since so much of the water will soak away. But taking everything into consideration, these lands are probably the most satisfactory on the island for production; they respond well to manuring, are easier and cheaper to cultivate, and their crops are always certain. Second, come the black cane and grass lands having a white calcareous subsoil. These occupy large areas in the hill regions in the northern and central parts of Habana and Matanzas, and are also found in the eastern provinces. These soils are fairly permeable to water, but cannot be cultivated so quickly after rains as can the red soils, nor on the other hand can they suffer so quickly from drought during the dry season. When first cleared such lands are very fertile, but their hilly character subjects them to constant loss from washing during heavy rains. Third, come the black lands with impervious clay subsoil, which are naturally very fertile, and when conditions are favourable they yield maximum crops. But most of these lands are quite level, and the subsoil holds the rainfall, so that the cane often suffers from a lack of drainage. In wet seasons, too, it is difficult to give sufficiently frequent cultivations to keep down the weeds. Improvement lies in the establishment of a system of drainage ditches and in ridging up in cultivation, whereby the water flows off in furrows between the rows.

The following particulars of the early history of the sugar industry in Cuba are taken from a report prepared by the Government in 1916, and will be found interesting :—

> In 1506 a Spaniard, Petro de Estehan, introduced sugar cane into Santo Domingo and shortly after in the island of Cuba. The sugar industry in Cuba acquired real importance when negro slaves were brought to the island from Africa, and especially when England, in 1713, formally agreed to furnish Spain with 144,000 negros, delivering

them in her Antillean colonies, most of which were devoted to the exploitation of the sugar industry.

In the year 1738 Santo Domingo, a French colony at the time, produced 71,150 tons of sugar, while the crop of Cuba did not reach 70,000 tons until 1817. In 1877 there were in Cuba 1190 sugar estates containing 17,701 caballerias of cultivated lands, with an agricultural zone equivalent to 43,505 caballerias. The sugar output for that year was 520,000 tons, and the number of negro slaves employed on sugar plantations was 90,156.

From the work "Los Ingenios," published by JUSTO GERMAN CANTERO in 1857, the following curious data concerning an important sugar estate in the year 1852 are taken:—

VALUE OF THE ESTATE:—

Land (272 caballerias)	$360,000
Buildings	$100,000
Machinery	$60,000
Slaves	$170,000
Work animals	$11,000
	$701,000

PRODUCTS OF THE ESTATE:—

Sugar (1,300,000 lbs. at 6 cents each)	$78,000
Molasses (60,000 gallons at 36 cents each)	$21,600
	$99,600

At that time the owners of sugar estates devoted considerable attention to the cultivation of corn as food for men and animals.

The abolition of negro slavery in Cuba, by royal decree in 1878, brought about a revolution in the sugar industry. Cultivation of cane was carried on independently of its manufacture into sugar, both of which had until said date been in the same hands, due to the existence of slavery. It was then that cultivation by independent "colonos" was started, formal contracts binding them to furnish cane to the estates in exchange for a specified amount of sugar. The first planter who adopted the new system of decentralization in Cuba was DON LINO MONTALVO, owner of the sugar estate San Lino, in Rodas, Cienfuegos.

The new feature—that is to say, the division of labour—originated the system of contracts that provide for a certain number of lbs. of sugar for every 100 arrobas cane delivered at the feet of the platform scales. It also brought about the name "Centrales" and the demolition of nearly 1000 small plantations transformed into tributary "colonos" of the larger and better equipped estates capable of increasing their capacity from 2000 or 2500 bocoyes (that is, from 10,000 to 12,500 bags of sugar) to 40,000, 50,000, 60,000 or 70,000 bags or more.

In 1890 the Central Constancia, in Cienfuegos, started by the MARQUIS APEZTEGUIA, became the most important sugar estate in the world, producing 135,600 bags of sugar. The Central installed the first crystallizer used in Cuba and introduced the system of injecting molasses into the sugar in the strike pans, producing sugar of 96° polarization.

At about the same time the central Hormiguero, belonging to PONVERT BROTHERS, installed the first furnace for burning wet bagasse. This was a very important improvement in the sugar industry, because it did away with the necessity of burning sun-dried bagasse, which needed a great deal of handling and kept busy a numerous gang of labourers, being possible only in times of slavery with very cheap hands. At the same time the invention of the multiple effect evaporating apparatus produced a great saving of the bagasse as fuel.

In 1878 began an era of wonderful industrial and agricultural evolution for Cuban sugar interests which lasted until 1896, when the second war of independence brought down the production to 212,000 tons.

After the second war of independence, it increased slowly until 1903, when the sugar production once again was more than a million tons, reaching as much as 2,913,367 tons in 1914 and 2,550,000 tons in 1915.

PRODUCTION OF SUGAR CANE.

The sugar industry in Cuba to-day, as in nearly all agricultural industries, is a direct result of the advantages of the climate and soil of the island for the growing of sugar cane. The methods followed by the planters and manufacturers both in field and in mill are the result of special conditions peculiar to the country, and, for that reason, cannot be easily changed while those conditions remain fixed. These methods are practically the same throughout the island, and are imposed on the industry largely through scarcity of field hands and the consequent high cost of labour. This applies in particular to the cultivation of the cane in the fields.

Preparation of the soil is commonly performed with ordinary ploughs drawn by oxen, while the clearing is done by hand with hoes. These methods of course are slow and costly. On the larger sugar estates traction engines drawing gang ploughs have been recently introduced, and these naturally reduce both time and cost of labour. There is indeed every reason to believe that these engines, especially where alcohol is used as the motive power, will soon come into general use, since this fuel can be made at a very low cost from cheap grades of molasses that would otherwise go to waste.

Sugar cane is usually planted in ridges 6 ft. apart. After the cane has been cut, and stripped of its leaves, it is divided into two or three pieces and loaded on ox carts that have a capacity each of 7500 lbs. The oxen haul it either to the mill or to some point on the nearest railroad.

In the more western provinces of the island, where the land has been planted in cane for many years, and has consequently become more or less exhausted, artificial fertilizers are coming into general use, supplementing the supply of leaves, tops, and mill residue, the filter-press cake, the furnace ash, and the unused grades of molasses, all of which are returned to the land. The decline in the fertility of many of the western provinces is quite evident from the fact that the average yield of cane there is about 17·7 short tons per acre, while the average of Camaguey and Oriente, the two eastern provinces, is 23·5 short tons. In the western lands six ratoon crops is about the limit, while in the newer and richer sections of the eastern provinces cane may be cut for 10 or 12 years, and in some instances for double that time without diminution in quality or quantity.

American plantations in Cuba are the only ones upon which intensive cane cultivation experiments are being carried on so far. On one of these the following assumptions were obtained in February, 1916:—

Fertilized cane weighs more than unfertilized.

The stalks of fertilized cane are longer than those which have received no fertilizer, and they have a great weight per foot, since they also possess a larger average diameter, while so far as determined, they have practically the same sucrose content.

Unfertilized cane has a higher fibre content than fertilized cane (0·6 per cent.).

The sucrose and purity in the normal juice from unfertilized cane is slightly higher than in that from fertilized cane.

Cane without fertilizer has more nodes per foot, which gives a higher percentage of fibre, which in return reduces the normal extraction and leaves a higher percentage of sucrose in the bagasse.

In taking the samples of cane from the fields a much higher percentage of waste and dried-up cane was noted in the unfertilized plats than in the plats which received fertilizer. The fertilized cane has more stalks to the hill than the unfertilized.

Finally, the production of sugar per unit of area is greatly in favour of the fertilized cane.

Nearly 80 per cent. of the cane produced in Cuba is planted, cultivated, brought to maturity, and harvested by the large body of farmers or "colonos." There are several types in existence. Some are independent and grow cane on their own land; others grow cane on company lands for at the most a nominal rental; still others grow cane on land leased to them by third parties. The method of paying for cane grown by colonos almost universally adopted in Cuba is to give either a certain percentage of sugar on the weight of the cane delivered, or its money equivalent. Usually liquidation is made twice a month at the average price of sugar in Havana or other port. Thus from 4½ to 7½ tons of sugar or its money equivalent are paid for every 100 tons of cane the colonos deliver, the higher sum being given for cane from the older lands where the cost of labour and production is greater. In some parts the competition between mills for the cane leads to a better price being given.

In the 1912-13 season there were over 20,000 colonos who grew and sold cane to the mills, of which number nearly 18,000 were native Cubans. It is found to be an advantage to divide the cane-fields amongst a large number of colonos, since these watch their allotments better against fire than the supervision of a large estate could do, while they secure the labour needed at harvesting more readily than the employer of a large area can. The contract system of payment in use between the companies and the colonos is also in use between the latter and the field hands they employ.

The colono, whether on company or on his own land, is the sole owner of the cane grown and in its production, harvesting, and hauling is practically independent of the company that purchases the cane. He has ordinarily more land than he uses and in many cases more cane than the company will take. Owing to these and other conditions, a general lack of system obtains in the cutting of cane. The colono or his cutters follow a go-as-you-please method, cutting only a portion of a field and then going to other parts where the standing cane shades them from the sun. As a result clumps of standing cane and gaps are left in the fields.

The colono system of cane production in Cuba, with all its disadvantages, is generally well understood in sugar-producing countries, but it has been assumed that if the system were abolished and cultivation carried on with scientific irrigation and fertilization, a great increase in cane and sugar production would result, with a consequent reduction in the cost of production. The investigations of the agents of the Bureau of Commerce have elicited, however, that as a rule plantations that were intensively cultivated and were fertilized or irrigated, or both, did not have a resultant greater production and lower cost per ton of cane and per ton of sugar. As a matter of fact, the increased tonnage of cane per acre was not sufficient to outweigh the increased labour and material costs.

Noël Deerr, after a study of the conditions existing in Cuba as compared with Hawaii, has laid it down that the comparatively backward state of Cuban agriculture is due chiefly to the combination of low selling price of the product and high rate of labour. With this combination agriculture is forced to adopt an extensive rather than an intensive policy. He considers that every possible encouragement should be given to increase the efficiency of the labour unit by adopting power-operated agricultural implements, the fuel for which can be obtained locally in the form of molasses alcohol.

MANUFACTURE OF RAW SUGAR.

Authentic and continuous records of sugar production in Cuba begin with the year 1853 when the production was 365,792 short tons. For the first 25 years thereafter the cane raised and the sugar produced were the work of negro slaves. With fluctuations the production increased steadily, attaining to 880,400 tons in 1873; but this total was not again reached till 1891 when the output was 931,247 short tons. The following year the million was exceeded, but from 1896 to 1900 the war caused a big drop to below 400,000 tons. From 1903 onwards the million ton mark has invariably been exceeded. In 1877, the last year of the slave period, there were 1190 sugar estates, while in 1916 the number was 188.

Cuban factories begin grinding in the latter part of December and work day and night including Sunday. Grinding continues till May in the western provinces, but in the eastern ones, especially in Oriente, it extends in some factories till August. Two shifts of employees work as a rule six hours on and six off, a total of 12 hours per man in 24. Many of the largest plantations and factories are owned and controlled by American companies whose general offices are in New York and Boston; they are steadily building new factories and re-constructing old ones; they are installing American machinery as a rule in their mills and equipping them with the best devices possible. Of the 179 factories existing in 1914, 36 were American, 59 Cuban, 54 Spanish, while the French possessed 6, the British 3, and the Germans 1. Most of the new factories recently built are in the provinces of Camaguey and Oriente.

As regards factory equipment, the records of fifty factories which were examined show that 9-roller mills were the most prevalent, there being 29 sets, while 12-roller mills claim 21 sets and there were two 15-roller trains. There were 51 triple effects, having an average heating surface of 11,334 sq. ft., and 45 quadruples averaging 22,900 sq. ft. Vacuum pans numbered 187, the number per factory varying from two to seven; as many as 48 crystallizers are to be found in one factory; while as regards the centrifugal plant, the average number per factory was 25, while the largest number in any one was 46.

The following is a description of equipment and operations in a modern first-class Cuban factory:—

The cane cars are placed in position for unloading by electric winches, and are unloaded by electric hoists, two hoists to each car. From 5 to 6 tons of cane are unloaded at one time. The empty cars are taken away by a locomotive. Each of the two sets of four Fulton mills grinds 96 tons of cane per hour. To supply these an average of 3 tons of cane per minute is unloaded by the electric hoists.

After the cane is unloaded it is carried up by an endless-apron elevator and dropped into the crushers. The crushed cane passes through four sets of 3-roller mills. After passing through the first rollers hot maceration water is added, increased in quantity for each successive set of rollers. For every 100 tons of cane 25 tons of water are added for maceration. At the rate of 95 tons per hour per tandem of roller mills the extraction at the mill is 95 to 96 per cent. sugar in cane. The mills revolve under hydraulic pressure of 400 to 600 tons. This factory equipment is classed a 14-roller mill. The mills are driven by a modern Corliss engine.

The bagasse is carried to the furnaces by a belt conveyor and is fed into them automatically from the conveyor. There is a steam-generating plant of 5000 H.P., consisting of 20 multitubular boilers with 20 furnaces. The latter are of the step-grate type. They consume 1 per cent. of wood in addition to the bagasse, which is 9 to 10 per cent. of the cane. On older lands the fibre percentage is, however, greater.

The juice runs from the grinding mills into a strainer, the juice passing through, while the trash is carried up and discharged. The strained juice is pumped up to the juice scale, where it is weighed. The two scales in use have a weighing capacity of 10,000 lbs. each; they have receiving tanks below, and from these scale tanks the juice is discharged into liming tanks; the diluted lime is kept in solution in a smaller tank. From the liming tanks the juice is discharged into pump tanks and is pumped to the heaters, where it is brought to a temperature of 200° F.

From the six heaters it is discharged into 13 defecators of 5000 gallons capacity each, where the temperature is brought to the boiling point and the heating is finished. The juice is allowed to stand and settle in the defecators, and then the clear juice is drawn off into tanks to be pumped to the evaporators.

The mud remaining in the defecators is discharged into tanks, where it is diluted and allowed to stand until the clear juice can be drawn off. The residuum in these tanks is pumped to the filter presses. There are 20 of these, with 42 leaves each. The mud from the first set of filter-presses is discharged into a mixing tank, where it is diluted with water and pumped through a second set of presses in order to extract the sucrose. The clear juice from all sources, defecator tanks and filter-presses, is pumped to the evaporator supply tanks. In the two quadruple-effect evaporators, having a total of 42,000 sq. ft. of heating surface, the juice is concentrated to a density of 61 to 62° Brix.

The syrup from the evaporators is pumped to the ten syrup settling tanks, from which it is discharged into the five vacuum pans (three calandria and two coil pans). In these pans the syrup is crystallized or boiled to grain. From the vacuum pans the massecuite is discharged into the crystallizers, of which there are 24 of 1400 cub. ft. each. These open crystallizers are mixing tanks where the mass is kept agitated until ready for centrifugalling.

Over the centrifugals are small mixers into which the massecuite runs from the crystallizers. From these mixers it goes to the centrifugals, of which there are 28, 40 inches in diam., with 15 × 15 meshes to the sq. in. The centrifugal capacity of each machine is 12 bags of 325 lbs. each per hour.

The sugar from the centrifugals is carried by belts to elevators and into the sugar hoppers and thence into the bags.

After centrifugalling, the molasses is pumped to molasses tanks, of which there are ten, six for first and four for second molasses.

Publications Received.[1]

***Soil Conditions and Plant Growth.** By Edward J. Russell, D.Sc., F.R.S. Third Edition, with diagrams. (Longmans, Green & Co., Paternoster Row, London.) 1917. Price, 6s. 6d. net.

We have been glad to notice the appearance of previous editions of this valuable work,[2] and now welcome a third in which considerable alterations have been made in the text and a new chapter added discussing the important and interesting subject of the colloidal properties of the soil.

It is shown by Dr. RUSSELL how soil properties are due to colloids. The formation of compound particles, the absorption of soluble manures, the retention of water (in part), the swelling of the soil when wet and its shrinkage when dry, are all colloidal phenomena. If we regard the mineral particles as the skeleton of the soil, we must look upon the colloids as clothing it in many of its essential attributes. How the colloids are arranged in the soil is not known, but the simplest view, and one in accordance with all the facts, is that the mineral particles, especially the fine silicate particles, are coated with a colloidal complex containing silica, alumina, ferric oxide, alkaline bases and phosphoric acid derived from the weathering of the rock material and the so-called humus. These various components are not in true chemical combination, but in a state of absorption, or solid solution. The complex is decomposable by changes in temperature, concentration of the soil solution, etc., but it decomposes continuously, and not in the *per saltem* manner of ordinary chemical reactions.

It is thus abundantly clear that the soil investigator of the future will have to be thoroughly familiar with the ways of colloids, and it is fully expected that much of the older work will require careful re-examination in the light of what has been done in this direction by chemists and physicists.

---

[1] Books and other Publications marked with an asterisk (*) can be ordered if desired through NORMAN RODGER, 2, St Dunstan's Hill, London, E.C. 3, but in that event the order should be placed with him direct and not through a bookseller. Those not so indicated should preferably be ordered from the source of publication, especially pamphlets to which no price is attached, as these are in many instances gratis. Postage as a rule is extra.

[2] *I.S.J.*, 1913, 483 ; and 1915, 330.

Concerning Sugar (Loose Leaf Service). By Truman G. Palmer. A Series of Loose Leaves incorporated in an expanding Binder with Tab Index. 11 × 8½ inches. Price by Subscription: $12 per annum plus $3 for the Binder. (Truman G. Palmer, 901 Union Trust Building, Washington, U.S.A.)

In the Spring of last year we recorded the inauguration of this ambitious series of loose leaf records which aimed at giving to subscribers from time to time particulars as to the history and statistics of the sugar industry in various parts of the world. Since then a number of valuable additions have been made to the collection, of which we might refer to the two following.

One is a 36-page inset giving the units of foreign currencies, weights, and measures, the predominant languages spoken in the principal countries of the world, postal rates, etc. This, it is self-evident, will prove of no little value to the subscriber, whether the business man or the student of sugar economics. It must have involved a very considerable amount of research in the handbooks of the various countries dealt with and is a most praiseworthy compilation. At the same time it would be perhaps too much to expect that errors or omissions should not creep in here or there. Thus, as regards British currency, mention is made, without qualification, of £5 and £2 gold pieces, and 3d., 2d., and 1d. silver pieces. The gold ones while legal coins are not in circulation, having been minted merely to celebrate Queen Victoria's Jubilee, and they are practically all retained by their holders as curiosities; and the silver pence referred to are coined annually solely to serve as Maundy Thursday alms given by the Sovereign and are not normally if ever seen in general use. On the other hand no mention is made of the crown or five-shilling silver piece, which though no longer minted is still considerably in circulation. But these are only minor blemishes in a very elaborate compilation.

The other addition is a set of questions and answers concerning sugar which give briefly and succinctly solutions to a host of questions such as have been repeatedly put to Mr. PALMER in the course of the past 15 years by students and inquirers. The definition of the different kinds of sugar, their prices, their geographical localities, the American sugar tariffs, the working of American sugar economics—all these are dealt with, and there must be few readers of this journal who could supply answers offhand to all the 152 questions here propounded.

This work, we must repeat, has to be subscribed for direct; the sets down to July, 1916, are covered by the first $12 subscription. The binder is a necessary part of the scheme, and no sheets are issued to applicants without it.

Transpiration as a Factor in Crop Production. By T. A. Kiesselbach. Research Bulletin No. 6, of the Agricultural Experiment Station of Nebraska, U.S.A.

Scale Insects and their Control. By R. T. Cotton. Circular 9, Government of Porto Rico, Board of Commissioners of Agriculture, Insular Experiment Station, 1917.

List of Government Publications on Agricultural Experiment Stations, Irrigation, Drainage. For sale by the Superintendent of Documents, Washington, D.C., U.S.A.

Irrigation of Sugar Beets. By F. S. Harris. Bulletin 156, Utah Agricultural College Experiment Station, 1917.

Irrigation. By R. Cecil Wood. Bulletin 71, Department of Agriculture, Madras, 1917. Price 1s. 6d.

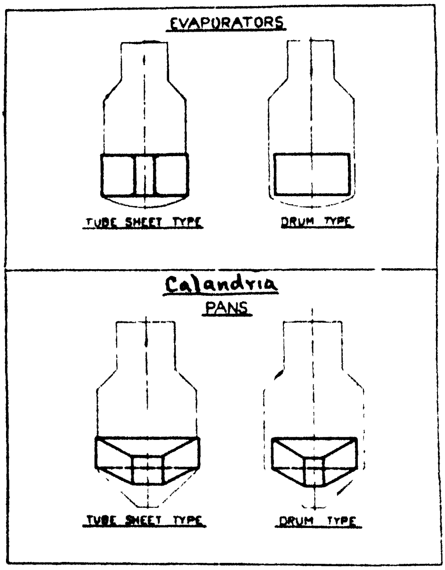
Correspondence.

MEASURING THE HEATING SURFACE OF EVAPORATORS.

A New Hawaiian Standard.

To the Editor, "The International Sugar Journal."

Sir,—Recognizing the great disadvantage, in comparing evaporator tests and in ordering new evaporators, of having different standards for measuring heating surfaces, the two iron works which supply nearly all the machinery for the Hawaiian sugar factories and the Experiment Station of the Sugar Planters' Association in Hawaii have agreed upon certain definitions for heating surfaces in the common types of evaporating apparatus. The definitions agreed upon are as follows:—



General.—The heating surface is the surface in contact with the liquid being evaporated.

Standard evaporators.—1. Tube-sheet Form —The heating surface is the inside surface of the tubes, from outside to inside of tube-sheets.

2. Drum Form.—The heating surface is the inside surface of the tubes, from outside to outside of tube-sheets, plus one-half the outside cylindrical surface of the drum, if of composition metal.

Lillie evaporators.—The heating surface is the outside surface of the tubes from the tube-sheet to the inserted ends.

Vacuum pans.—1. Coil.—The heating surface is the outside surface of the coils, excluding the tail-pipes.

2. Calandria.—(*a*) Tube-sheet Form. The heating surface is the inside surface of the tubes from inside to inside of tube-sheets, plus (1) the net area of the top tube-sheet, if of composition metal, or plus (2) one-half the net area of the top tube-sheet, if of sheet-iron, or plus (3) one-quarter of the net area of the top tube-sheet if of cast-iron. (*b*) Drum Form.—The heating surface is the same as for the tube-sheet form, plus one-half the outside cylindrical surface of the drum, if of composition metal, or plus one-quarter of the outside cylindrical surface of the drum, if of sheet-iron. No allowance is made for the outside surface of the drum, if of cast-iron.

The idea at the bottom of the agreement was that it is important to have a common standard even if the actual heating surface in any given case is not defined with strict accuracy. The definitions are equitable, it is believed, as between the different types of evaporators, if not minutely accurate, and it would be advantageous, for the sake of uniformity, if they were generally adopted.

Yours truly,

Honolulu, October 1st, 1917.

R. S. Norris.

Germany is reported to be short of phosphates, and her leading industrial and agricultural companies and societies have joined in an offer of large premiums for the discovery of further deposits which can be utilized for the manufacture of this class of fertilizer. Some small deposits exist on the Lahn river, and are being worked intensively, but the production from this source is quite inadequate to cover present requirements. More than £2,400,000 worth of phosphate was annually imported before the war.

Brevities.

Japan is now showing a considerably increased production of sulphur, due partly to shipments to Europe, and partly to the growing demand at home.

The *Lancet* recommends the use of powdered sodium fluoride as a means to driving away cockroaches from domestic quarters. This powder, while fully effective, keeps indefinitely.

Statistics of the production of centrifugal sugar in Formosa, as issued by the Sugar Industrial Association of Taiwan, show that the output for 1916-17 reached the record quantity of 605,503 short tons, of which amount 295,040 tons were exported.

Among the many substitutes for glycerin being used in Germany during the war for different technical purposes are: a concentrated solution of sucrose and invert sugar; and an aqueous solution containing 21 per cent. of magnesium chloride and 40-50 per cent. of glucose.

A recent leaflet published by the Board of Agriculture recommends the use of glucose for making jam, and also advises the admixture of salicylic acid with jam for preserving purposes, and the addition of saccharin to jam as a substitute for sugar. These recommendations are rightly taken exception to by the Medical Officer to the Kensington Public Health Centre, who points out that glucose should only be used when guaranteed free from all traces of arsenic; that salicylic acid is an undesirable preservative, having an undoubted effect upon health, even in small quantities; and that the use of saccharin cannot generally be advised.

In March of this year the Swiss Government granted a concession for the manufacture of 7000 tons of alcohol per year, and more later, from calcium carbide, to the Elektrizitwerk Lonza, of Gampel and Basle, Switzerland. The process consists in passing acetaldehyde vapour mixed with an excess of hydrogen over finely divided nickel, which acts as catalyst, water and alcohol being formed, the former of which is frozen out. In Germany during the past few years patents have been taken out for the production of alcohol from acetylene by means of acid mercury salts of aldehydes differing from their alcohols by a deficiency of two atoms of hydrogen.

Fly poisons for both outdoor and indoor use are frequently necessary. In Mesopotamia (says the *Agricultural News*) the method of exposing sodium arsenite with sugar yielded good results, and in hot climates, where flies come readily to sugar solutions, this mixture is specially effective. But arsenic solutions being poisonous to other life, a search for equally serviceable substitutes is being made by the Imperial College of Science and Technology in London. So far, laboratory tests show that fluorides and iodates used in 1 per cent. strength in sugar solution have proved to be excellent for indoor use. In some hospitals salicylates are used as fly poisons, one ounce of salicylate to five pints of water poisoning flies for some time.

A new cane disease is stated to have broken out in Porto Rico the last three seasons and to be spreading steadily. The one noteworthy and constant symptom is the peculiar mottling of the leaves, which are marked with numerous white or yellow spots and stripes with irregular indefinite margin; a comparison is in fact suggested with the Sereh disease, though the two do not correspond in detail. It has been found that the cuttings from affected canes invariably reproduce the disease, no matter how they are treated, or in what soil planted. The effect on the canes varies from reduced yields to total failure of the crop, while the resulting juice is liable to cause a good deal of trouble in the factory. No ordinary cane disease remedies have had any effect, and rotation of crops is advocated as a temporary expedient.

Review of Current Technical Literature.[1]

Determination of the Amount of Sugar in Baked Articles in Connexion with the Cake and Pastry Order, 1917. *Analyst, 1917, 42, No. 498, 293-295.*

The following method has been proposed by the Government Laboratory for the determination of the amount of sugar present in baked articles examined under the Cake and Pastry Order of this year. It was considered and approved by a conference of members of the Government Laboratory, of the Council of the Society of Public Analysts, and of representatives of the biscuit manufacturers.

I.—Preparation of Sample.

(a) Biscuits and similar articles in a fairly dry condition.—The sample, or a thoroughly representative portion of it, is rapidly ground in a mortar or by passing it through a mincing machine, thoroughly mixed, and used for analysis. *(b) Bread and Cakes in a moist condition or with an outside crust.* A slice, not less than half an inch in thickness, is cut through the loaf, weighed, and dried at a moderately low temperature to a moisture content of about 10 per cent., when it can easily be ground. It is weighed again, ground, and mixed, and the powder used for analysis. *(c) Buns and Cakes in a moist condition.*—Several buns or cakes are taken, weighed, broken coarsely, and dried at a low temperature to a moisture content of about 10 per cent. The weight is again taken, the pieces ground and mixed, and the powder used for analysis. *(d) Articles containing Fruit (raisins, currants, dates) in which sugar naturally occurs.*—A considerable portion of the cake or bun is weighed, broken rapidly on a sheet of paper, and the fruit removed and weighed. The drying of the cake from which the fruit has been removed is continued as under *b*; and the fruit is reserved for the determination of the sugar.

II.—Analysis.

(1) *Moisture.*—A portion, about 5 grms., is weighed out from the prepared sample, and dried at 100° C. until the weight is constant. The loss in weight is corrected for the total loss in those cakes in which preliminary drying previous to grinding had been carried out, and in those cases where fruit had been removed to the cake containing fruit.

(2) *Sugars.*—Ten grms. of the prepared sample are ground up with water in a mortar, and transferred to a 250 c.c. flask, using in all about 200 c.c. of *cold* water. The flask is shaken at intervals during 30 minutes. The solution in the case of some articles, for example, biscuits, does not usually need a clearing agent. If it is necessary to use one, basic lead acetate followed by sodium sulphate to remove the excess of lead, or alumina cream, or copper sulphate solution, may be employed. The liquid in the flask is then made up to 250 c.c., filtered, and the sugars determined in the filtrate. 50 c.c. of the filtrate are measured into a 100 c.c. flask and inverted as follows: 5 c.c. of hydrochloric acid of 38·8 per cent. are added, and the flask placed in a water-bath maintained at 70° C. The solution should reach a temperature of 67-69° in 2½–3 minutes. It is maintained at 60° C. for 7–7½ minutes, the total period of heating being 10 minutes. It is then cooled at once, neutralized, bulked to 100 c.c., and filtered. The reducing sugars in the filtrate are determined either by gravimetric or volumetric process, the total copper-reducing power being calculated as sucrose. The quantity of "cane sugar" obtained is to be corrected to the original moisture of the sample, and, if fruit has been removed, to the cake containing fruit. From the total quantity

---

[1] This Review is copyright, and no part of it may be reproduced without permission.—(Editor, *I.S.J.*)

thus found, the sugar derived from added fruit in the case of fruit cakes is to be deducted. This is estimated by determining the amount of sugar in the fruit cake, and the loss in sugar it has sustained, on the basis of the following average amount of sugar in natural dried fruits, calculated on *water-free* sample:—

	Total reducing sugars as sucrose
Raisins	80 per cent.
Currants	80 ,, ,,
Figs	70 ,, ,,
Dates (without stones)	70 ,, ,,

A deduction of 3 per cent. (3 units) is made from the total amount obtained for sugars naturally present in flour, or derived from flour in course of baking. To provide for variations in sampling, in methods of analysis, and in the amounts of sugar in the different materials employed, an allowance of 2 per cent. (2 units) is made.

Direct Polarization of Cane and Beet Sugar Products without Treatment by Basic or Normal Lead Acetate. *H. Pellet.*

Bulletin de l'Association des Chimistes de France, 35, 138-140.

For a long time it has been possible to produce in the beet sugar factory. juices which after carbonatation are very slightly coloured, giving syrups which likewise are light in colour, even if sulphurous acid has not been used. Such juices and syrups are generally very clear, or may be rendered thus by a simple filtration. This being so, the question naturally arises whether it is necessary to effect defecation by the addition of basic lead acetate previous to carrying out the polarization, as is customarily done. In any case, treatment with this reagent does not immediately produce a clear filtrate, for the liquid being relatively pure, a voluminous precipitate is not obtained, and filtration gives at first a more or less cloudy solution, especially if a sufficiently dense paper-filter be not used.

On the other hand, alumina cream, a little tannin, or again a little kieselguhr, may be added previous to filtration to produce an excellent effect. In fact, if a good paper be used, a few decigrms. of kieselguhr will generally suffice. But the important point is whether the same result is obtained with the use of basic lead acetate as without it, and careful experiments have been carried out by Mr. Pellet to establish this point. He used in all the tests the same 100-110 c.c. flask, and a particularly sensitive saccharometer, one which, as a matter of fact, had a normal weight of 20 grms. Readings were made by three persons accustomed to using the instrument mentioned, and their results, carried out with a carbonatated cane juice, were as follows:—

Direct polarization without lead defecation	Direct polarization using lead defecation	Direct polarization without lead defecation	Direct polarization using lead defecation
13·04	13·04	11·94	11·94
12·59	12·59	12·12	12·13
12·78	12·79	12·79	12·80
12·52	12·52	11 68	11·68
12·32	12·32	11·66	11·66

It is thus evident that in the case of cane juice treated by carbonatation the direct polarization without lead defecation may be adopted for ordinary routine control. In the case of cane juice which has been submitted simply to lime clarification, it is difficult to obtain perfect limpidity, though generally this may be secured by the aid of kieselguhr. Similarly, beet juices treated by carbonatation may be polarized directly, but after taking the precaution to add a few drops of acetic acid to neutralize the alkalinity.

Review of Current Technical Literature.

GRAVIMETRIC ESTIMATION OF REDUCING SUGARS IN CANE PRODUCTS. ***George P. Meade and Joseph B. Harris.*** *Journal of Industrial and Engineering Chemistry, 8, 504-509.*

It is shown, in confirmation of the work of other investigators, that results vary with the quantity of lead acetate solution used for clarifying the solutions. When the excess of lead is removed as oxalate, the weight of copper obtained is from 4 to 5 per cent. higher than when the lead is removed as sulphate or carbonate. A clear solution, suitable for copper reduction methods, may be obtained by treating the sugar solution with kieselguhr alone, the results thus obtained being slightly lower than when lead and oxalate are employed. It is considered that the cuprous oxide should be oxidized to cupric oxide, and weighed as such and not as cuprous oxide.

MECHANISM OF FERMENTATION. ***A. Fernbach.*** *Journal of the Federated Institutes of Brewing, 22, 354-367.*

In presence of calcium carbonate, fermentation is slightly retarded for a day or two: by the fourth day the amount of sugar is about the same with or without calcium carbonate, whilst subsequently there is increased activity under the influence of calcium carbonate. After the second day there is a great increase in the production of acids in the solutions containing calcium carbonate, about five times as much acid being produced under these conditions as in the absence of calcium carbonate. The chief acid formed in the fermentation process was found to be pyruvic acid, which is readily converted into carbon dioxide, and acetaldehyde, which is reduced to alcohol. The small amounts of acetaldehyde found in fermented liquids are therefore residues which the yeast has failed to reduce to alcohol, and not the result of the oxidation of alcohol. It is suggested that succinic acid may be formed by the condensation of 2 mols. of pyruvic acid and the transformation of the lactone into pyrotartaric (methylsuccinic) acid, which should yield succinic more readily than hydroxyglutaric acid, as suggested by Ehrlich. In addition to pyruvic acid, certain amounts of succinic, acetic, and lactic acids were found.

DELICATE TEST FOR ALDEHYDES. ***Anon.*** *Journal of Industrial and Engineering Chemistry, 1917, 9, No. 9,906.*

Fazi in an Italian contemporary gives details of a new delicate reagent which allows of the detection of 0·006 mgrm. of furfural, these being as follows:—To the solution of the aldehyde in chloroform, 2 or 3 drops of a solution of acenaphthene in chloroform are added, and afterwards with care 1 c.c. of concentrated sulphuric acid. A green ring changing to red-violet is formed in the presence of the body in question. If the tube be shaken, the sulphuric acid is coloured green, and then red-violet. This reaction distinguishes between aromatic and aliphatic aldehydes, since the latter do not give any coloration, formic and acetic aldehydes, for example, giving white precipitates, which consist of condensation products. Aldoses and carbohydrates containing an aldehyde group, which give furfural or aromatic aldehydes on treatment with cold concentrated sulphuric acid, also yield the reaction. In the case of lactose, the green colour appears at the end of a few minutes, passing to violet in about 10 minutes. Maltose reacts more slowly than lactose.

ACCESSORY FACTORS IN PLANT GROWTH. ***Otto Rosenheim.*** *Biochemical Journal, 1917, 11, 7-10.*

An aqueous extract of Bottomley's "bacterized peat" was found to have remarkable growth-stimulating properties, which cannot be ascribed to the manurial value of the small amounts of nitrogenous and other substances present in it.[1] It is believed that the effect produced on plant growth is due to a substance or substances analogous to the vitamines or accessory substances in animal growth. Alcohol or aqueous extracts of the treated peat give a precipitate with phosphotungstic acid, whilst similar extracts of ordinary peat or garden soil give only a faint opalescence or remain clear. The positive outfall of certain colour tests also indicates the presence of a substance similar to a vitamine in the treated peat.

J. P. O.

---

[1] See *I.S.J.*, 1914, 238, 536; 1915, 96, 117, 192, 516, 577; 1916, 198, 233, 357, 472; 1917, 284, 429.

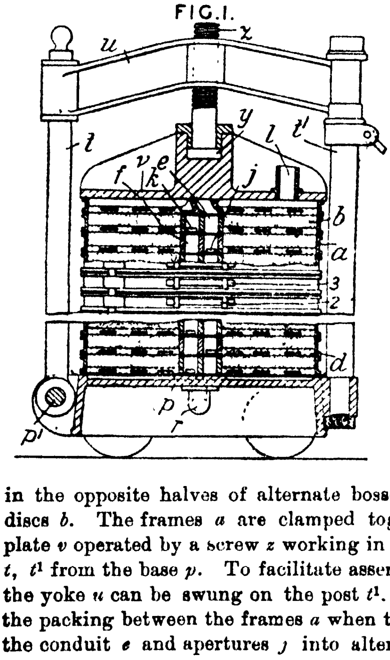
Review of Recent Patents.[1]

UNITED KINGDOM.

VERTICALLY DISPOSED FILTER-PRESS. *Frank F. Briginshaw*, of 5, Dalberg Road, Brixton, London, S.W. *104,936* (*4636* of 1916). Applied for, March 29th, 1916. Accepted, March 29th, 1917. (Four figures).

The invention consists in an arrangement of the filter pulp cakes or discs which are contained within suitable metallic frames in such a manner that they in themselves constitute the body of a vertically disposed filter without any external casing, the inlet and outlet to and from the filter pulp cakes being disposed in the centre of the apparatus instead of as commonly adopted on the outside thereof, such elements forming a complete filter-press, being held and retained to a base-plate. This is preferably mounted on wheels to make the same portable, by means of two standards, columns, or vertical rods connected at the top by a suitable bridge-piece in the centre of which is provided a screw by which pressure is applied to a top or cover-plate mounted on the uppermost element, whereby the superimposed elements or series of filter frames are maintained in position. The liquid to be filtered is led into and beneath this cover-plate and finds its way into the central distributing pipe. The object of this particular construction is to afford simple and efficient means whereby the whole of the filter elements may be readily exposed to the operator to facilitate their removal and replacement within the shortest space of time. Means are provided whereby the bridge-piece may be swung out of the way and one or both of the standards or columns to which the same is attached may be easily removed so as to leave the whole of the filter elements free for the operator to handle without having to take into consideration the framework as is commonly used for assembling the elements in such filter-presses.

FIG. I.



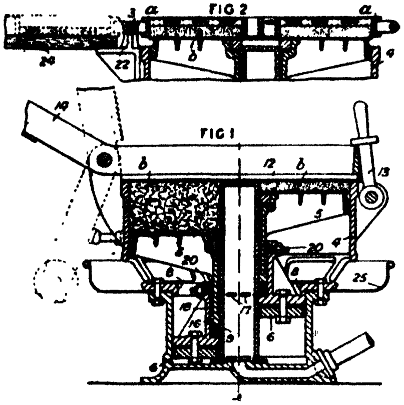
Turning to the illustration, there is shown a filter-press comprising a series of frames *a* supporting pulp cakes or discs *b* and having central hollow bosses divided by a partition to form inlet and outlet conduits *e*, *f* respectively, the bosses being provided with apertures *j*, *k*, in the opposite halves of alternate bosses, communicating with the spaces between the discs *b*. The frames *a* are clamped together between a wheeled base *p* and a pressure plate *v* operated by a screw *z* working in a yoke *u* supported by preferably telescopic posts *t*, t^1 from the base *p*. To facilitate assembling, the post *t* is pivoted at p^1 to the base, and the yoke *u* can be swung on the post t^1. Ball bearings at *y* minimize frictional wear on the packing between the frames *a* when the screw is operated. Liquid fed in at *l* flows by the conduit *e* and apertures *j* into alternate spaces *d* between the discs *b*, then filters through these discs into the remaining spaces and passes by the apertures *k* and the conduit *f* to the outlet *r* The discs *b* may be carried by light inner frames *a*, fitted into outer rings of malleable iron or cast steel. Trunnions *3* formed on the handles *2* of each frame *a* enable the frames to be pivoted to pulp-moulding appliances, described in Specification 105,323 (see following abstract), to facilitate the insertion of the discs *b* into the frames. Eyes are provided on opposite sides of the frames *a* to be engaged by pins of different diameters to facilitate assembling the press.

---

[1] Copies of specifications of patents with their drawings can be obtained on application to the following:—*United Kingdom:* Comptroller of the Patent Office, Southampton Buildings, Chancery Lane, London, W.C. (price, 6d. each). *United States:* Commissioner of Patents, Washington, D C. (price 5 cents each) *France:* L'Imprimerie Nationale. 87, rue Vieille du Temple, Paris (price, 1 fr. 05 c. each). The date given in the heading of United Kingdom specifications is that of the application of the patent.

Apparatus for Compressing Filter Pulp Cakes. *Frank F. Briginshaw*, of 6, Dalberg Road, Brixton, London, S.W. *105,323* (*3553* of 1916). Applied for, March 29th, 1916. Accepted, March 29th, 1917.

Apparatus is described for compressing filter pulp cakes or discs of the kind employed in that class of filter described in Specifications 104,936 (see above), and comprises a cylinder in which is provided a base or table for supporting the pulp which is compressed by the action of a hydraulic ram that raises the base or table towards a lid or cover secured to the top of the receptacle or cylinder, said ram having a determined amount of travel to complete the compression of the pulp cake or disc, and supplementary means for the ready removal of the prepared disc to the exterior of the apparatus to facilitate application thereto of the supporting frame with which it constitutes the element of a filter-press.



As is shown in the figure, it comprises a cylinder *4* having a cover *12* against which the pulp is pressed by a piston *5* actuated by an hydraulic ram *6*, a stop *8* serving to arrest the travel of the ram, as shown on the right side of Fig, *1*, so that a definite thickness is imparted to the pulp cake *b*. A catch *13* secures the cover *12*, which is pivoted and provided with a counter-weighted arm *14*. A smaller ram *16*, working in a cylinder *18* carried by the ram *6*, serves to eject the moulded cake from the cylinder *4* to the position shown in Fig. *2*, where the metal frame *a* described in the above-described Specification is slipped over it, the trunnions *3* on the frame being inserted in bearings on a bracket *22*, so that the frame and the pulp cake can be turned over on to a table *24* for removal to the filter-press. Stops *20* limit the travel of the ram *16*, to which water is passed through ports *17* in a column *6*, which serves also as a core for moulding the central aperture in the filter cake and as an air cushion to facilitate expulsion of the water from the rams. The ejecting ram may be replaced by a lever or equivalent device A tray *25* and a pipe serve to catch and convey away water expelled from the pulp.

UNITED STATES.

Apparatus for the Revivification and Decarbonization of Animal Charcoal (Bone Black). *Robert S. Kent*, of Brooklyn, New York, U.S.A. *1,207,178*. Patented, December 5th, 1916.

In the apparatus described, the char is dried, revivified, and its carbon content altered as required by the action of gases heated by a furnace located within an outer drying chamber, this consisting of a rotatory drum having internal flights for raising and lowering the material. It is a modification of the inventor's two previous patents.[2]

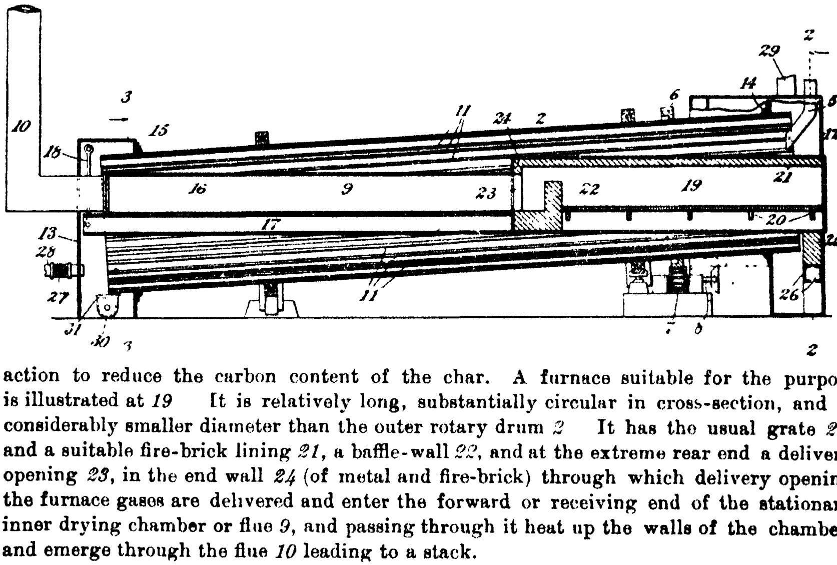
Referring to the figure, *2* illustrates a drying chamber in the form of a rotary char-conveying drum suitably supported on roller bearings. It is placed, as is usual, at a slight angle to the horizontal. The material may be introduced into the drum through a spout *5*, projecting into the receiving end of the drum. Near the receiving end, provision is made for continuously rotating the outer drying chamber or drum *2*, the means shown for the purpose being the usual large external gear *6*, meshing with a driving pinion *7*, and suitably supported and carried by a driving shaft *8*.

In connexion with the rotary drum *2*, an inner chamber or shell is employed for the purpose of circulating a heated gaseous drying medium, usually products of combustion from a furnace or other suitable source of heat, through the apparatus from one end to the other of the same. Such an inner drying chamber is shown at *9*. It is stationary, and disposed substantially horizontally. At its forward end it is intended to be connected with the furnace *19*, supplying the gaseous heating medium for circulation from the front to the rear, from which products of combustion may be delivered through a flue *10*, to a stack (not shown). The drum *2* is capable of raising and showering the moist char in a manner which is well understood, suitable char-conveying buckets or flights being used for this purpose. These may be either straight-edge or saw-tooth flights of the type shown in the aforesaid patent. The inner drying chamber or flue *9* may be supported and mounted in substantially the manner disclosed in the previous application, it being shown as stationary and as mounted on substantially stationary supporting means. Its cross-section is also preferably such as to facilitate the descent of the char being showered and to permi the char to fall to the bottom of the rotary drum *2*. Here its cross-section is that of an equilateral triangle with one vertex uppermost, and its side walls *16* sloping to such an extent as to prevent accumulation of the char thereon. There is of course no communication between the two chambers *2* and *9*, as the latter is intended to carry products of combustion from the furnace, which must be kept out of contact with the char being treated.

---

[2] U.S. Patents, 914,052 and 766,502.

One of the principal features of the apparatus is suitable means for supplying to the interior of the apparatus sufficient heat for drying the char and also heating it up (both through contact with heated walls and with a heated gaseous medium) to a point at which the temperature will be high enough to bring about the desired oxidizing or reducing action to reduce the carbon content of the char. A furnace suitable for the purpose is illustrated at *19* It is relatively long, substantially circular in cross-section, and of considerably smaller diameter than the outer rotary drum *2* It has the usual grate *20*, and a suitable fire-brick lining *21*, a baffle-wall *22*, and at the extreme rear end a delivery opening *23*, in the end wall *24* (of metal and fire-brick) through which delivery opening the furnace gases are delivered and enter the forward or receiving end of the stationary inner drying chamber or flue *9*, and passing through it heat up the walls of the chamber, and emerge through the flue *10* leading to a stack.

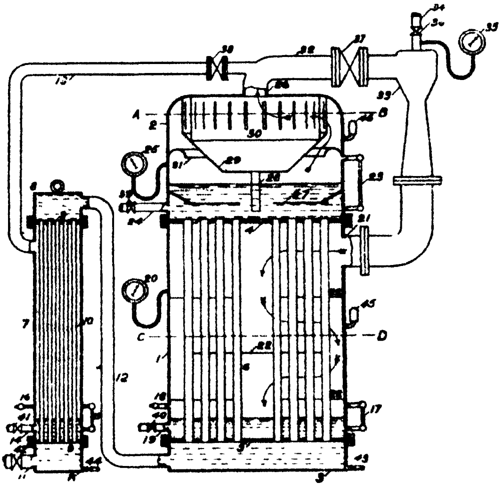


As before stated, the char to be treated is supplied through the pipe *5*, and is delivered into the interior of the outer rotary drum *2*, and on falling to the bottom is caught by the flights *11* and carried around by them, and showered through the space in the drum from a point near the top of the rotary drum. The construction of the flights is such that the char is preferably not spilled from them until the flights pass some distance beyond the central vertical plane of the furnace and drum, in order that the material may not lodge on top of the furnace or on top of the flue *9*. Thus the falling char is subjected to the action of a suitable heated gaseous medium for drying it, and for also altering the carbon content thereof as desired, this medium being usually either heated air or heated carbon dioxide obtained in any usual manner. As the char is tumbled around in the drum by being caught up and spilled in showers by the flights, the moisture in it is rapidly removed, and the organic matter upon the surfaces and within the cells of the particles is either oxidized and driven off or reduced to carbon by the action of the oxidizing or reducing gas, and in the event of the latter being used, there is a further addition of carbon due to the breaking up of the carbon dioxide and the depositing of its carbon content in and on the particles of char. During this period the temperature will of course be at a point sufficient to assure the proper carrying out of the process, the degree of heat depending upon the condition of the char under treatment, and upon the nature of the treatment which it is to undergo.

EVAPORATION BY THERMO-COMPRESSION. *William L. de Vaufre*, of Annapolis, Maryland, U.S.A. *1,213,596*. Patented, January 23rd, 1917.

Referring to the illustration, the evaporator consists of shell *1*, separator head *2*, and water bottom *3*. The upper tube-sheet *4* is placed between the shell *1* and the separator head *2*; and the lower tube-sheet *5* is placed between the shell *1* and the water bottom *3*, while evaporator tubes *6* extend between the tube-sheets *4* and *5*. A preheater may also be attached as shown and will have a shell *7*, water heads *8*, tube-sheets *9*, and preheater tubes *10*.

The solution feed enters the preheater at pipe *11* with control valve *42*, flows through preheater tubes *10* and from thence passes to the water bottom *3* through connecting pipe *12*. Vapour from the separator head *2* is supplied the preheater through vapour pipe *13*, and the condensed vapour or condensate is drained from the preheater through pipe *14* In the evaporator shell *1* is a gauge glass *17* to show the level of the condensate therein and air relief cock *18* is provided just above the water level. The condensate is drained through pipe *19* with control valve *40*. Vapour, usually steam, enters the shell at *21* and is caused to pass over and among the evaporator tubes *6* by the baffles *22*, of which there may be any number



On the separator head *2* there is provided a gauge-glass *23* to note the level of the solution therein. Pipe *24* with control valve *39* is provided for the discharge of the solution. Pressure gauge *25* indicates the pressure within the separator head of the vapour arising from the solution. The vapour is carried off through outlet *26*, either to the compressor through vapour pipe *32* with valve *37* therein, or to the preheater through vapour pipe *13*. Within the separator head is suspended a baffle or baffles *27* over the ends of the evaporator tubes *6*, in order to prevent the boiling solution from these tubes being projected above the surface of the solution. Return pipe *28* projects downward from separator pan *29*, and the separator grids *30* extend from the circumference of pan *29* to the top of the separator head and are secured thereto. The grids *30* consist of a plurality of concentric drums containing vertical narrow slits or other openings, which are staggered in the several drums. A splash-guard extends around the circumference of the separator head.

A compressor *33* compresses the vapour from the separator head *2* and discharges it into the shell *1*. This may be of the jet type, as shown, or rotary, or reciprocating. The steam to operate the compressor is supplied through the pipe *34* with throttle valve *36*, the pressure being indicated on the gauge *35*. Drain valves *43* and *44* are provided on the evaporator and the preheater respectively. A pressure relief valve *45* is attached to shell *1* to prevent it being subjected to an excessive pressure in starting the compressor *33*, while a similar valve may also be provided on the separator head.

United States.

(Willett & Gray, &c.)

(Tons of 2,240 lbs.)	1917. Tons.	1916. Tons.
Total Receipts January 1st to October 25th	2,238,900	2,403,393
Receipts of Refined ,, ,,	—	—
Deliveries ,, ,,	2,249,865	2,390,418
Importers' Stocks, October 24th	—	17,053
Total Stocks, October 24th	44,210	69,652
Stocks in Cuba, October 24th	48,096	186,700
	1916.	1915.
Total Consumption for twelve months	3,658,607	3,801,531

Cuba.

STATEMENT OF EXPORTS AND STOCKS OF SUGAR, 1914-1915, 1915-1916, AND 1916-1917.

(Tons of 2,240 lbs.)	1914-15 Tons.	1915-16. Tons.	1916-17 Tons.
Exports	2,208,071	2,615,524	2,802,468
Stocks	261,707	297,176	112,060
	2,469,778	2,912,700	2,914,528
Local Consumption	63,200	66,155	73,400
Receipts at Ports to September 30th, 1917	2,532,978	2,978,855	2,987,928

Havana, September 30th, 1917 J. GUMA.—L. MEJER.

United Kingdom.

EXPORTS OF SUGAR.

	MONTH ENDING SEPTEMBER 30TH.		NINE MONTHS ENDING SEPTEMBER 30TH.	
	1916 Tons.	1917. Tons	1916. Tons.	1917. Tons.
BRITISH REFINED SUGARS :—				
Refined and Candy	104	116	4,069	851
Total	104	116	4,069	851
FOREIGN AND COLONIAL SUGARS :—				
Refined and Candy	54	4	878	23
Unrefined	16	56	3,149	569
Various Mixed in Bond	—	—	—	—
Molasses	2	1	806	21
Total Exports	**176**	**177**	**8,902**	**1,464**

THE

INTERNATIONAL SUGAR JOURNAL.

No. 228. DECEMBER, 1917. Vol. XIX.

☞ All communications to be addressed to "The International Sugar Journal," 2, St. Dunstan's Hill, London, E.C.

Cheques and Postal Orders to be made payable to "The INTERNATIONAL SUGAR JOURNAL," and not to individuals.

☞ The Editors are not responsible for statements or opinions contained in articles which are signed, or the source of which is named.

The Editors will be glad to consider any MSS. sent to them for insertion in this Journal and will endeavour to return the same if unsuitable; but they cannot undertake to be responsible for them unless a stamped addressed envelope is enclosed.

Notes and Comments.

The Brussels Convention: The British Standpoint.

The West India Committee has done well to address a letter just lately to the Government to ask once more whether the latter will now subscribe to the view long held by the Committee (and others) that the Brussels Convention of 1902, the Additional Act, and all subsidiary Protocols, Declarations, and Agreements were all annulled by the outbreak of war in 1914. Attempts have been made before now to get an expression of opinion from the Government on this point, through the Foreign Office if we remember aright, but so far without result. The latest appeal, we note, is made to the Colonial Office, this Department being assumed to have an interest in the matter owing to the fact that no preference can be given to sugar produced in our Colonies till six months' notice has been given to the International Sugar Committee.

We have repeatedly pointed out in our pages since the war broke out the grounds on which it is claimed with reason that the Convention has been annulled through the war. But it is clear that with a view to avoiding any offence to the neutral members of the Brussels Convention no hurried or drastic step has been taken to denounce that measure, even by France the country which seems to have the most urgent reasons for dispensing with the agreement. France, as we have shown, has decided to assume for convenience's sake—or perhaps we should say for diplomatic reasons—that the Convention still exists, and she has taken the alternative and equally effective step of giving notice to withdraw from its provisions on and after September 1st, 1918.

Our Government may or may not think the Convention is voided by the war; but their sole connexion with that measure is due to an entirely gratuitous undertaking that they would even after they withdrew from it in 1913 not grant any preference to sugar produced within the British Empire without giving six months' notice. It rests with them then to give this notice, failing any definite belief on their part that the Convention is now null and void and that they have hence complete liberty of action in respect of their treatment of British produced sugar. They owe it to our colonies to free the latter as soon as possible from an unnecessary restriction, and if the Colonial Office have at heart the interests of the sugar industry in British colonies they ought without any further delay to get the matter settled, and so enable plans to be made for increased sugar crops with the assurance that these will not be barred from a reasonable preference in our markets owing to discredited pre-war treaties.

As France retires from the Convention next September and thereafter regains complete liberty of action for her sugar industry, we suggest that His Majesty's Government might arrange to give that six months' notice not later than the 1st of March next, in which event the notice would mature on the same date as will the 12 months' notice which the French gave to the Belgian Governmant on 1st September last. Not that it is necessary to wait till next March; but it seems highly desirable that our Government should not fall behind their French ally in the date of withdrawal. And it must not be overlooked that by the undertaking made on behalf of the British Government under dates August 2nd, 1912, and June, 1913, with the Brussels Sugar Commission, the six months' notice covered not only the intention to grant a preference to sugar produced within the British Empire but also any departure from the fundamental principles of the Convention, e.g., by imposing a higher Customs duty on beet sugar than on cane. It will hence be necessary for the Government, in order to obtain general liberty of action, to give notice of withdrawal from all its undertakings specified in Sir EDWARD GREY's letter of August 2nd, 1912, addressed to the British Chargé d'Affaires at Brussels, wherein Great Britain's continued adherence (in the spirit) to the Convention was affirmed.[1] For otherwise, in the absence of any establishment of the fact that the Convention has become null and void through the war, we appear to be precluded from penalizing German sugar at some future date, unless we have given six months' previous notice to that effect.

Sugar Rationing: Amended Arrangements.

That the system of sugar rationing which is about to be enforced within the United Kingdom is intended to serve as the basis for a general application of food rations, if the latter prove absolutely necessary, is becoming clearer every day. It is some months since the decision to ration the sugar was made, and although the new scheme does not come into force till the end of the year, the interval has proved none too long wherein to work out the details. In fact, a modification has been found necessary which may involve very hurried arrangements at the last minute. As we show elsewhere, new instructions have been issued to deal with that considerable percentage of the population which is more or less floating and which would be penalized under the prior arrangement whereby the consumers were registered by households and not by individuals. The intention is to retain the household grouping as far as it persists, but, in the event of any person ceasing to belong to a given household, to grant him instead facilities to buy his sugar individually wherever he happens to be by means of coupons issued to him at intervals. This is obviously the nucleus of a system of rationing by individuals, and it is very likely that if it is found to work satisfactorily, the future rationing of other articles of food (which seems an inevitable event before many more months are over) will be based on the same arrangement.

All this rationing is going to be a very expensive business for the country, and it is not at all clear that it will result in entire satisfaction to the consumer, especially to the poorer members of the community. But failing a radical reduction in the food consumption on the part of an appreciable section of the population, no alternative exists but to regulate their liberty to obtain food. A determined effort between now and Christmas is being made to preach up and down the country the doctrine of voluntary rationing. But it is doubtful whether it will succeed sufficiently to avert compulsory measures. To judge from what one hears in private domestic circles there is far too much selfishness rampant in the community, and amongst both rich and poor there are too many individuals who will do nothing till they are made to, and who meanwhile are determined to eat their full without regard to the circumstances. To such it is useless to preach self-denial for national reasons; only the law of force will affect them.

---

[1] For the Official Reports of these undertakings, see *I.S.J.*, 1912, 497; and 1913, 360-364.

It will be interesting to see whether the United States will succeed in getting the voluntary principle adopted and followed to such an extent as to render any like system of compulsory rations unnecessary. True the food question is not so acute in the States, but there is already manifesting itself a general shortage of all commodities, and strict economy is being preached all round. It will be greatly to the credit of the United States citizens if they respond. Meanwhile nothing but praise is due to their Government departments and officials for the very wholehearted way they have, from the outset of joining the war, taken steps to conserve the energies and supplies of their country in the common cause; and it does not appear likely that any of the expensive mistakes we made in this country during the first two years of the war will be their lot. If they *have* learnt by our experience, they have shown unexampled anxiety to learn; and they have undoubtedly tended to go beyond the limits of that experience and have shown a refreshing originality in devising ways and means.

After-the-War Industries.

The Government have recently drawn up a Bill for the control of the imports and exports of the United Kingdom for at least three years after the war, chiefly to enable them to exercise full control against any attempts of enemy countries to dump the products of what are called "key" and other important industries over here before our own nascent attempts to produce these products for ourselves can mature and become firmly established. Evidently it is thought that this method of control is more comprehensive and more adaptable than a general tariff system which would take time to evolve. And we take it the Government would have the power to prohibit certain imports altogether if thought necessary.

If an interview given by the chairman of one of the Government After-War-Trade Committees to an evening paper is anything to go by, it is evident that the Government intend by this means to give a measure of protection to certain new and vital industries within our midst, and plans are said to have been completed for the establishment in this country of large works connected with the following amongst others: optical glass, sugar beet, dye stuffs, and chemicals. The reference to sugar beet confirms the supposition that the Government mean sooner or later to support the establishment of this industry within our agriculture, and that the Kelham project with which they are already associated is assured of a successful start. It is to be feared, however, that no attempt can now be made to get this factory going till after the war, since the labour shortage not only makes it undesirable to undertake building operations just now, but there would probably be difficulties in getting the necessary machinery. Anyhow, if the Government stick to their resolve to aid the scheme and if they take care that the preliminary efforts to produce sugar are not spoilt by the ill influence of a market swamped with cheap foreign sugar, we can afford to wait the further interval which still lies between now and the inauguration of the new industry.

Pessimists there are who opine that unless something is done at once, the whole benevolent resolve on the part of the Government will fall through when peace returns. But we think credit should be given to the Government for an earnestness of purpose that will assuredly bear fruit one day. And the longer the war lasts the more complete will the public education become and the greater the general desire to retrieve the mistakes of the past. Against such feeling, no recalcitrant Government could hold out with any success.

Cuba's Dominance.

In our last issue we briefly referred to the fact that owing to the scarcity of available sugar in the United States due to the war the Cuban sugar producer was at length coming to his own and we affirmed that he should see to it that his claim was recognized for good and all. We might have added that opinion on this point is much more strongly expressed in that American sugar paper which has the closest ties with Cuba, viz., the *Louisiana Planter*. This organ opines that if the Cubans were strong enough to cut themselves aloof from the New York financial interests, and were able to finance themselves, they would have the whole sugar world at their feet. "Now is the time for the Cubans who produce the sugars of the western world to state their own independence and to organize their own sugar exchange, and with adequate capital, and adequate warehouse room, to finance their own sugar crops and keep them out of the hands of the men who have been utilizing every possible effort to break down the price of sugars, while they are at the same time securing from 50 to 100 per cent. greater margin for the little that they do to 96° test sugar in order to make it 100 per cent. pure sugar." Hitherto, as our contemporary points out, the Cubans have had to send their sugars forward unsold to any of the great American markets, where there are practically but three buying interests and those three acting generally in such apparently concerted action as to justify the belief that their lines of action for months and for years have been to specifically depress the price of Cuban sugars, for the purpose, as our contemporary believes, of rendering it easy for them to largely increase their margin of gain in the refining of the 96° sugars.

But the war has given the Cubans an unexpected opportunity and they would be foolish if they allowed it to pass without endeavouring to break up the prevailing monopoly. It is unfortunate however that any struggle which may result is bound to affect adversely—if it does affect—the course of the sugar supply to the United States and her Allies in Europe; and it is to be hoped that any negotiations which may arise between the American Food Administration and the Cuban representatives will lead to a recognition of the claims of the Cuban sugar producing interests; but it must be confessed that the composition of the International Sugar Committee at New York as regards its American representatives is not of such a character as to warrant concessions being made if they can possibly be avoided.

The Personnel of the International Sugar Committee.

In fact the composition of this Committee has met with considerable criticism on the part of the sugar producers, especially the cane growers of the Southern States; and their organ, the *Louisiana Planter*, has been extremely bitter over the way that HOOVER has filled the sugar committee at New York with men representing solely refining interests. It avers that he has placed the domestic sugar industry, and the colonial sugar interests of Hawaii and Porto Rico, in the hands of the recognised enemies of the sugar industry, viz., the Refining Trust, who have for years past more or less controlled the operations of the sugar market at the expense of the sugar growers and have thwarted all the latter's attempts to become independent of them by placing direct consumption sugars on the market. The consequence is when all sugar interests in the States are being besought to work together in the common cause so as to deal successfully with the war-time shortage of that food, a certain amount of suspicion is being legitimately shown by aggrieved parties because they have no representative on the International Committee and they see what they take to be their trade enemies placed in full power of all sugar operations. This suspicion is reflected in an unwillingness on the part of New Orleans to supply New York with sugar, and, as we show below, the former has been able to get the upper hand for the time being and refuse the refiners greatly needed supplies of raw.

On the whole we think it was a mistake on the part of HOOVER to fill the three American places on the International Committee with refiners' nominees; *one* would have been ample. The other places might have been filled by representatives of the sugar growers, and of the sugar dealers and brokers. The growers might indeed have had two representatives, one for domestic and colonial cane, and the other for domestic beet. If some such appointments had been made, there would have been no cause for discontent and suspicion, and all parties might have pulled together in harmony. But as matters stand, the unrepresented Louisiana interests are playing the part of passive resisters to the Sugar Administration, while both the Cuban producers and the United States middlemen are not without their suspicions that the Administration is playing the game of the refiners at the expense of the other parties. Thus it is feared that the control over the wholesale trade by the Administration in the supposed interests of the consumer is tending to work for the elimination of the jobber or middleman, and this fear is not lessened by the fact that the American Sugar Refining Co. is just now pushing a considerable business in sales direct to the retailer. As for Cuba, the latest news at the time of writing is that the producers are holding out for 4¾ cents. f.o.b. Cuba, while the Sugar Administration offers 4½ cents. In view of the extra cost of production in that island and the increasing shortage of labour, the Cubans are not likely to accept the lower figure, but they may compromise on 4·60 cents.

The Louisiana Situation.

The position in regard to Louisiana is briefly this. With the stoppage of supplies from Cuba till the new crop comes to hand, the Atlantic refiners have been looking to Louisiana to supply at least 100,000 tons of raws to keep them going. But the Louisiana sugar producers have other ideas, and seeing as they thought the opportunity to act independently for once of the sugar refining trust, they have endeavoured to dispose of their output elsewhere at remunerative prices, much of it in the form of crystallized white or direct consumption sugar. Had there been no sugar administration, it is probable that they would have scored effectively at the expense of the refiners; but unfortunately for them the Food Controller has had his say in the matter of prices, and some acrimony seems to have resulted. The planters first understood that they would be allowed to sell their white sugars at the same price as refined, viz., at 8·35 cents less 2 per cent. But it was soon made clear to them that this price would only be allowed where other refined sugars were sold on this basis, that is in the eastern price zone; otherwise they were forbidden to sell above 7·25 f.o.b. New Orleans, in the case of white sugars or above 6·35 in the case of raws. The refiners originally offered an average of 6·225 for raws at New Orleans, but increased their offer in the end to the 6·35 maximum, while they made great efforts to whip up the planters to supply 100,000 tons for refining. But the latter are disinclined to make 96° test sugar, finding the manufacture of white sugars even at the 7·25 basis more profitable. As a consequence, it is said to be doubtful whether the refiners will get as much as 25,000 tons, all the more as exceptionally heavy frosts have supervened in Louisiana, and instead of the 278,000 tons looked for, the present crop is now likely to fall below the 200,000-ton mark.

The Food Administration is desirous of placing all Louisiana and direct consumption sugars on a basis of 7·25 cents, so as to make the 7·25 price rule over a wider base than at present exists. This voluntary agreement to a price which has been accepted by the beet interests does not, however, meet with the planters' approval, and they are likely te hold out for a better figure. Meanwhile, what whites have been available from the much reduced crop have been eagerly absorbed by buyers on the local New Orleans exchange at the full price of 8·35 cents!

Notes on American Sugar Production.

By our American Correspondent.

The features of the month in the sugar situation here have been the gradual working out of the Food Administration's plans for the control and distribution of the coming crop and the very real scarcity of supplies that has prevailed throughout the eastern half of the country. The latter is the first pinch that the American public has felt since we entered the war, and has given them their first serious intimation of the fact that they will presently be under the necessity of doing without some things to which they have been accustomed and of cutting down in the use of many others.

No serious hardship has been inflicted on consumers by the scarcity of sugar. In most communities it has still been possible to obtain it in limited quantities, although grocers have doled it out to their customers in amounts of 1 to 3 lbs. at a sale. For the manufacturing confectioners, however, and for some others who use sugar in considerable quantities, the situation has been more serious. The confectioners have been cut down to 50 per cent. of their normal supply, and some of them are being compelled to curtail their output in consequence.

One of the curious developments of the situation has been the appearance in retail shops in New York and a few other eastern cities of "raw" sugar being offered direct to consumers. The amount handled in this way was small, consisting of a single shipment of Peruvian centrifugals of about 98° test. While purchasers took this sugar eagerly, it is probable that further transactions of this sort will be discouraged, for the reason that the sale of this sugar to consumers at 9¼ cents the lb.—the same price fixed for refined granulated—is manifestly unfair to domestic producers who have agreed with the Food Administration to sell their centrifugals at 5·80 cents the lb.

Even in the western States, where 92 beet factories and the two Pacific Coast refineries handling Hawaiian cane raws have been steadily in operation, distributors in many cities have experienced more or less difficulty in keeping supplies up to the requirements of their trade. This has been due to the increasing absorption of transportation facilities in the movement of material contributing directly to the conduct of the war. Sugar is accumulating in large amounts in western warehouses, and it is becoming evident that the extensive distribution of beet sugar in the eastern States during the period before new crop Cubas become available as planned by the Food Administration will be impossible.

Notes on American Sugar Production.

The negotiations which the Food Administration has had under way with the various groups of producers have progressed steadily, and it now appears probable that all sugar from producing sections ordinarily supplying this market will be sold at prices fixed by voluntary agreement. Following the action of the beet sugar producers in voluntarily agreeing to limit the price of their output to 7·25 cents the lb., seaboard basis, Hawaiian and Porto Rican interests have agreed tentatively to a rate of 5·80 cents for their 96° test centrifugals which, with the refiners' margin added, will place their sugar, when refined, on virtually the same basis as the beet product.

Conferences between the International Sugar Committee and a commission representing the Cuban Government have been under way for the past fortnight in an effort to arrive at an agreement as to the price which is to prevail for Cuban centrifugals. It is known that there is no broad difference of opinion between the two parties to the conferences, and it is possible that by the time this appears in type a definite decision will have been reached. Opinion in the trade anticipates a final agreement on a price of 5·90 cents, duty paid, landed in New York, as probable for 96° test Cubas. If this price is finally agreed upon it is anticipated that the price of domestic centrifugals will be made to conform to it.

While it seems reasonably certain, therefore, that the American people—and those of Great Britain and France in so far as they draw supplies from this side of the Atlantic—will receive their sugar at a very reasonable price during the coming year, the outlook as to the volume of the supply is not so reassuring.

Practically every development that has taken place in the past two months has been of a sort to cause a sharp revision downward in the estimates of production. Hawaii is just emerging from a prolonged drought which in many places has burned the cane down to the very roots. *Facts about Sugar* publishes a cable report from the islands giving a tentative estimate of 498,000 long tons as the probable yield for the coming crop. If this figure proves to be correct it will mean a falling off of roundly 80,000 tons as compared with the crop now ending.

The sugar beet harvest likewise is yielding an actual outturn below earlier expectations. The beet-slicing campaign was late in starting, and in some sections labour to harvest the beets and cars to transport them to the factories have been lacking. The latest estimate of probable production is 715,000 tons instead of nearly 800,000 tons hoped for when the beet seed was put down.

In Porto Rico nothing has happened thus far to modify the early estimate of a crop of 446,000 tons or about the same as last season. The official figures for Porto Rico's 1917 production have just been published, by the way, and place the crop at 449,114 tons.

In Cuba, where the grinding season started last week with the commencement of operations at Central Manati, the conservative opinion is that the crop will run very little if any above last season's production of approximately 3,000,000 tons. There is some question as to the extent to which the burning of cane fields during the rebellion last spring will affect the crop, but it is considered unsafe to look for any appreciable increase over last year.

From the above tentative estimates it appears likely that American sugar production during the coming season will show a falling off of 100,000 tons or more as compared with the season just closed. With no appreciable increase in Cuban production and with reserve stocks completely exhausted, it seems entirely probable that the dearth of sugar will continue to a modified extent both in Europe and America during the coming year unless shipping is made available for the movement of Java and Philippine sugars on a larger scale than during the present year.

New York, November 20th.

The Defence of Industry.[1]

VII.

THE VICISSITUDES OF THE BRUSSELS CONVENTION.—(*Continued.*)

The *Journal des Economistes* of September 15th, 1917, contains a most interesting article from the pen of M. YVES GUYOT, the great French political economist and free trader, entitled, "*La Question des Sucres en 1917.*" He had published, in 1901, a little book, entitled, "La Question des Sucres en 1901," the substance of which we afterwards listened to with great interest at the Royal Statistical Society in 1902. At that time he denounced the system of bounties on the production and exportation of sugar with great vigour, but we did not know till now what an active part he had been playing in the struggle for the success of the Brussels Conferences of 1901-2. He here tells us the interesting and somewhat surprising story; we give it in his own words, which have a special flavour:—

"In the month of February, 1902, I went to Austria-Hungary to try to detach the Government from the German Syndicate, of which some members realized that such a state of things could not last, but of which the majority were strongly attached to their bounties. I saw, at Budapest, the Minister of Commerce, with whom I was acquainted, and who replied: 'I know nothing about it, and I do not want to know. Go and see the President of the Syndicate." On this advice I went to the President. I was informed that he was at Berlin. This reply did not surprise me. I had an interview in the afternoon with the Minister of Finance. He told me very politely that he was too busy with his Budget to be troubled with the sugar question, and both Ministers agreed in giving me the advice to 'go to Vienna to see the Austrian Minister of Finance—he understood the question.' I was surprised to find Hungarian Ministers exhibiting so much humility, and so ready to efface themselves behind an Austrian Minister. I was stupified—and took the train. The Austrian Minister, Professor of Political Economy, author of a great work, member of the Political Economy Society of Paris, was well acquainted with the question and with the burdens laid on the consumers and on the Budget by this *régime* of bounties. He called a meeting of a certain number of refiners and sugar producers, before whom I made my statement. My calculations showed that the refiners, much less numerous than the producers, got much the most out of it. No one contested my figures. One of the influential members of this meeting, walking back to the hotel with me, said: 'You have given the figures of our profits. They are exaggerated, but no one can contest them because we are all mistaken.' Two days afterwards I received a despatch from our Ambassador informing me of the adhesion of the Austro-Hungarian Government to the principle of the Convention."

This was a great diplomatic feat, but M. YVES GUYOT tells us of one still more interesting. On January 20th, 1902, he went to see Sir MICHAEL HICKS-BEACH, then Chancellor of the Exchequer, to ask him to strike bounty-fed sugar with a penal clause, without which the Brussels Conference could not come to an agreement. He replied: "What are you asking of me? I am the most fortunate of Chancellors of the Exchequer. The Anglophobes of the Continent, thanks to their bounties, in paying more than my Customs duty, furnish me with part of the expense of the South African War."

This is a curious reply. They would have paid more than the Customs duty, and thus have furnished him with extra revenue to pay for the war, if he had done what M. YVES GUYOT asked—levied a countervailing duty on bounty-fed sugar. But that is exactly what he refused to do. To the present writer he said at last: "I agree with you now. But do not talk about a countervailing duty, talk about prohibition." This he said as a free trader, not being able to see that the one would be the restoration of free trade in sugar, but that the other certainly would not. He was still obsessed by the dogma—"duty for revenue purposes only."

---

[1] For previous articles of this series, see *I.S.J.*, 1916, 153, 254, 494; and 1917, 249, 396, and 492.

M. YVES GUYOT continues his story. "I made him see the force of the arguments of a *free trader* on the necessity for a free-trade country not to favour the aggressive protectionism of Cartels and bounties. This conversation took place about noon; at six o'clock in the evening Sir MICHAEL HICKS-BEACH told me that the penal clause was agreed to. . . . . . He was kind enough, in announcing this news to me, to introduce it with the following words: 'Lord SALISBURY said to me that we could refuse nothing to the great friend of England.' I had invited to dinner a friend of Sir MICHAEL HICKS-BEACH, Mr. GEORGE GRANVILLE LEVESON-GOWER, and Sir NEVILE LUBBOCK. When I told them the news they were kind enough to say (only too truly): 'You have obtained what no Englishman has been able to obtain.' The Germans remained convinced, up to the last moment, that the British Government had not consented to the penal clause; and I was informed in Paris and London that they had attached to my person *une police.*"

In a review of the adventures of the Sugar Convention these stories must not be omitted; they are most interesting, and all British sugar industries are very grateful to M. YVES GUYOT for his valuable and timely assistance at a highly critical moment.

In his new essay, "The Sugar Question in 1917," M. YVES GUYOT protests against the recent denunciation of the Convention by the French Government. The ground he takes up is that the Convention, as he very truly urges, was a step towards the restoration of free trade in sugar, and that, therefore, its denunciation is a reactionary move towards the old bounties and Cartels. He forgets that the Convention, unfortunately, contained the germs of a Cartel bounty, which has been flourishing now in Austria ever since 1907, and has enabled the industries of sugar production and refining in that country to obtain an increase of price in the home market of nearly £3 per ton, quite enough to give an enormous artificial stimulus to production and refining in Austria-Hungary, to the great detriment not only of all natural producers and refiners, but also of the consumer. He does not know that Germany was making great efforts to follow the example, but had some difficulty in getting all the members of the industry to come in and join in the "Combine." Without a perfectly tight and universal agreement no successful Cartel can be formed. Their last effort to force recalcitrant members into the fold was to offer to British buyers a rebate on their purchases. They attained their object by this means, and we heard that the new German cartel was at last an accomplished fact. Then came the war. All this shows that, in point of fact, the Convention had become a failure before the war killed it. A Convention to secure the abolition of cartel bounties is, as the British delegates were warned at the time, a mere "scrap of paper" if it permits of a bounty of nearly £3 a ton.

But that is not all. M. YVES GUYOT also forgets that, in 1907, the British Government evidently regarded the Convention as a mere "scrap of paper" when they calmly repudiated their solemn undertaking on which the whole Convention was based, and in faith of which the other Parties to the agreement abolished their bounties. In both cases the unfortunate Convention became a mere "scrap of paper," and M. YVES GUYOT need not regret its final disappearance. It had already died a natural death when the war broke out. In future we can abolish bounties without the assistance of Conventions, by the simple and most effective remedy of a countervailing duty. It either succeeds in abolishing the bounty, or, if not, it restores freedom of competition in British markets, and at the same time adds to our revenue, without injury to the consumer and with great advantage to the taxpayer.

In the course of his essay M. YVES GUYOT quotes (from the *Journal des Fabricants de Sucre's* French translation) certain passages from a little book published by the British Empire Producers' Organization, entitled "A Short History of Sugar, 1856-1916,—A Warning," the writer of which had occasion to quote a passage from a book on "The Elements of Reconstruction." The writers of that book divide their proposals into five heads, of which the first is "Economic Syndications upon a National or Imperial Scale." M. YVES GUYOT adds in brackets "(cartels)." This is quite a misconception, there is nothing in the book to indicate that its authors have any such idea. Books of this kind are often written by those who have no practical knowledge or experience of the details of industrial or commercial life. A syndicate like the German sugar cartel, created for the sole purpose of raising prices in the home market, would never be tolerated in this country. It would be at once declared illegal, just as it is in France.

Let us now take a brief look at the position of the British consumer and of the British sugar industries at the moment when the birth of the Brussels Convention was about to take place. In the year 1900 we were consuming annually about 1,600,000 tons of sugar, and this sugar, with the exception of 129,000 tons—a negligible fraction—of cane sugar, imported for special purposes, consisted entirely of European beetroot sugar, produced under the stimulus of the bounty system. Here was at last the absolute monopoly of the British market by bounty-fed beetroot sugar, long foretold by those whose industries were being pushed out, but always scoffed at by those who, in the name of a spurious Free Trade, refused to permit British industries to enjoy freedom of competition in their own markets, and who were moving heaven and earth to prevent the bounties from being abolished. They knew nothing about the facts of the situation—such facts as the entire monopoly of the British market by the foreigner, the dependence of the world for more than half its sugar consumption on the success of the European beetroot crop, and the consequent great rise in the price of sugar every time the European crop was deficient. All this was a sealed book to them; the only thing they knew was that the cry—"Free Trade in danger"—was good for winning votes for their party, so they shut their eyes to facts and cried aloud that the price of sugar would be raised £5 a ton if bounties were abolished. The Convention was signed and ratified, and the result has been that during the 11 years of its life, up to the first week in August, 1914, the price of sugar ranged round about the cost of production, sometimes below it, that is, from £8 to £10 per ton, just about a penny a pound, except when there was a bad beetroot crop, as in 1904, 1909, and 1911, when the unfortunate consumer had to pay the penalty for allowing beetroot sugar to obtain a monopoly in British markets.

This 11 years' experience is a pretty good refutation of the cry raised in 1902 that the price of sugar would be raised £5 a ton. The temporary high prices for a few months in 1905, 1909, 1910, and 1911 were caused by the bounties, not by their abolition, because they had artificially stimulated the beetroot industry to such an extent as to make the world's price of sugar dependent on the climatic variations in a small portion of the European Continent.

During the monopoly of our market by Continental beetroot sugar the British sugar refining industry had to give way to an annual importation of nearly a million tons of foreign refined. We have seen the result during the three years of war. Our refiners, for that reason, cannot now turn out more than 750,000 tons a year, and we have to go to New York for the remainder of our refined sugar, to supply the balance of our consumption of 1,600,000 tons, eked out with what white sugar we can scrape together from Java and Mauritius.

These are all points either caused by or the cause of the various adventures and troubles of the Convention period. We now turn to the one great catastrophe, for which we have to thank the delusion of the fanatics who cry "perish all British industries so long as we adhere to the only true faith—duty for revenue purposes only." There was a change of Government in 1906. The new-comers at once began to wage a most vindictive war against the Sugar Convention. The fight culminated in June, 1907. During the preliminary contest it was evident that the Government obtained their information not from British sugar producers and refiners, but from a small coterie of confectioners (not the whole body) who persistently declared that the Convention had, by shutting out Russian bounty-fed sugar, deprived the country of its supply of sugar. It soon became apparent that the Government were determined to turn a deaf ear to the facts by which this assertion was completely refuted, and to take action solely on the false evidence furnished to them by their faithful political supporters. It was useless to point out to them facts well known to every sugar expert in Europe, namely that our supplies of sugar from Russia were a mere drop in the ocean, and that there were ten million tons of sugar free to come to us, from which we selected, without let or hindrance, the 1,667,800 tons which we imported in 1906, the largest importation then on record. The absence of Russian and Argentine sugars, the only prohibited imports, had absolutely no influence on our supplies because those sugars simply went elsewhere and liberated an equivalent quantity of other sugar available for the British market. Our imports of Russian and Argentine sugar were, moreover, a perfectly negligible quantity. But, whatever the quantity might be, the fact remains that wherever they went they simply displaced other sugar, and whatever price they were sold at was the world's price. If that price was reduced by their sale, Great Britain benefited with the rest of the world. The whole foundation on which the Government's policy was based is, therefore, partly a pure delusion and partly a fabrication invented for party purposes. A Government Minister in the House of Lords showed the Government's profound ignorance of the subject by declaring in the House (June, 1907) that the high price of sugar in 1905,—really and solely caused by the bad beetroot crop, which reduced the world's supplies by the serious amount of 1,200,000 tons—was caused by our being unable to obtain our usual quantity of the Russian and Argentine crops—about 80,000 tons at the outside. It is to be hoped that in future our Cabinet Ministers will take the trouble—as those in France, for instance, do—at all events to endeavour to master the subjects with which they have to deal.

On the 1st June, 1907, the Foreign Office addressed to the British Minister at Brussels a despatch with reference to the coming time when it would be necessary to renew the Sugar Convention for another term of years. The important words of the despatch are as follows:—"His Majesty's Government have come to the definite conclusion that the limitation of the sources from which sugar may enter the United Kingdom, whether by prohibition or by the imposition of countervailing duties, is inconsistent with their declared policy, and incompatible with the interests of British consumers and sugar-using manufacturers, and that consequently it will be impossible for them to continue to give effect to the provisions of the Convention requiring them to penalize sugars declared by the Permanent Commission to be bounty-fed."

The events which followed this statement must form the subject of a further article. We have pointed out above the reasons why this declaration has no foundation in fact. It may be added that "the declared policy" of the British Government in 1902 was exactly the opposite policy, and that it was solely on the good faith of that policy that the principal countries of Europe were induced to abolish their bounties. The undertaking of Great Britain—her "declared policy"—was the basis on which the whole Convention rested, and without which it became "a mere scrap of paper."

The sequel is most interesting and instructive. G. M.

Sugar Rationing in the United Kingdom.

The following is the new scheme of Sugar Registration devised by the Ministry of Food for coping with the numerous cases of travellers or removals. It amplifies the previous arrangement of household sugar cards and will ultimately succeed the latter entirely.

The Food Controller has approved a scheme of individual registration under which will be included (*a*) those who by reason of their occupation are frequently moving from place to place, and (*b*) those who, having been registered as members of a household, have for any reason ceased to be members of that household.

(1) In the case of those persons who have either never been registered on a household sugar card or who have been so registered but have since ceased to be members of that household, the method of obtaining a sugar supply under this scheme is as follows:—Application forms, together with a printed envelope may be obtained from any post office which when filled in by the intending consumer must be posted to a new department, the Sugar Registration Clearing House of the Ministry of Food. If the form is in order a ration paper will be posted to the applicant on the production of which at any post office he will be able to obtain sugar coupons covering a period of eight weeks. The coupons will allow the holder to purchase sugar to the amount indicated from any retailer in any locality. At the end of eight weeks the holder of the ration paper may obtain a new supply of coupons from the post office on the presentation of his ration paper.

(2) In the case of those persons who have originally been registered as members of a household and are still so registered, a Declaration Form has to be procured from the retailer and filled up by or in respect of each person included in a Household Sugar Card and is given to the retailer with whom the latter sugar card has been registered. The retailer supplies in exchange a "Retailer's Sugar Ticket" in respect of each such person, and this ticket has to be produced when sugar is being purchased from the retailer with whom the person is registered. It can moreover be used as a removal ticket. In that event the person ceasing to be a member of a household will claim his ticket from the householder and can exchange it on surrender at a Post Office for eight weeks' supply of coupons. The ticket so surrendered will be forwarded to the Registration Clearing House where a Ration Paper will be prepared and delivered to the owner who can thenceforward draw coupons at the proper intervals. The ticket will then be sent to the Food Control Committee of the district in which it is registered, and this committee will debit the ledger account of the retailer with the amount of sugar affected. It should be added that once the holder of a Retailer's Sugar Card has had occasion through temporary or permanent removal to exchange it for coupons, he will thereafter come permanently within the coupon system. This affects persons going away on holiday who have to buy sugar while so absent.

Government Control of Trade.

Report of a Private Parliamentary Committee.

The members of the House of Commons possess a Commercial Committee for watching trade interests generally, and in view of the extent to which the Government has the last few years taken control of trade, they not long since appointed a special Sub-Committee to consider and report as to whether the Government was carrying out the distribution of commodities throughout the country with due regard to the necessity for maintaining low prices for vital articles of consumption, and to the interests of the commercial classes; and whether also the Government in its overseas purchases of commodities was paying due regard to the commercial interests of the country.

This Sub-Committee made enquiries in many quarters, and considered the questions referred to them, after consultation with various traders' organizations and individuals, by whom they were furnished with a variety of information. They have just issued their Report, and in it they give expression to the conviction that in many cases Government control has not secured continuity and sufficiency of supplies, nor has it invariably conduced to their distribution at reasonable prices. There are complaints that the system of control has been arbitrary in its operation, and that the fullest use has not been made of the knowledge and experience of those most largely engaged in the ordinary channels of the business of import and distribution.

Much of the Report is occupied with Appendices containing the reports of the traders' organizations and other sources of information, and there is a memorandum dealing with "Sugar" which we reproduce below.

MEMORANDUM ON SUGAR RECEIVED BY THE SUB-COMMITTEE.

At the outbreak of war, the stocks in the country were small, owing to the fact that, for many years, we had been relying for our supplies upon shipments of beet sugar from Germany, Belgium, Austria, Russia, etc. It was not, therefore, customary for the refiners and dealers to hold very large stocks.

Upon the outbreak of war a small syndicate was formed which immediately bought up all the free sugar it could lay hands on. The consequence was an enormous rise in the price of sugar, brought about by the action of this speculative syndicate. Consequently, people at once lost their heads, and there was a great outcry (especially by the Labour Members of Parliament) for the Government to intervene and take over the control of sugar. At the same time certain interested people went to the Government and induced it to place the purchases in their hands.

It is believed that no member of the committee that was appointed by the Government had any previous experience in this class of business, that is, the buying and shipping of sugar, attending to finance, freight, insurance, and other necessary work incident to a merchant's business.

At the same time, the sugar refiners were in rather an awkward position, and, with a rising market, they found themselves in the buying market in competition with the Government.

The Government Committee that was appointed rushed in and commenced buying wildly without in any way considering whether it had the ships to carry the sugar, or whether it could arrange for the finance. The consequence was that their first purchases in August, 1914 (we take the basis of Java sugars), were made at 12. 6d. per cwt. free on board, and by October they drove the price up to 20s. per cwt.

This very considerably frightened the refiners, who were afraid of buying at the high prices, as they thought it probable (in fact it was almost certain) that if the business had been allowed to be carried on through the usual channels prices would have declined. There is no doubt, therefore, that the refiners, wishing to be sure of a profit, helped to decide the Government to take over the whole thing, and to hand the sugar that had to be refined to the established factories, paying them (it is said) the high price of 5s. per cwt. for refining.

In September, 1914, when the Government thought they had bought up everything in all parts of the world, they realised that there were sources of supply of which they had never heard, but which were known to the merchants.

Before the production of beet sugars had attained its present magnitude, imports of sugar were made to this country, not only from Java, but from the Philippines, from China, from the Madras coast, from Mauritius, from the West Indies, and many other countries. It was the Sugar Bounties which ruined the sugar trade of this country originally and brought about the position that we found ourselves in in 1914.

A firm forty or fifty years ago imported considerable quantities of China sugars to this country, when there were several refineries in the East end of London round by the London and St. Katharine's Docks. All these were closed down owing to the Sugar Bounties, and thousands of people were thrown out of employment.

When the Government and their advisers found that they had made a mistake, and discovered that it was probable there would be large imports of sugar over and above what they had bought, fearing that their purchases would show a loss, they were induced to prohibit the import of sugar by private firms except under licence. When licences were applied for, they were generally refused.

The firm were interested in 12,000 tons of Argentine sugar, and had chartered two steamers, the "Imperial" and the "Wentworth," both at 20s. per ton, the former for loading the middle of October, the latter for loading the middle of November. The "Imperial" was actually half loaded with sugar when the prohibition came in force. That was on the 19th October, 1914.

They and their friends had advanced on this sugar £125,000, and they applied to the Government for a permit to import this sugar into the United Kingdom. It was refused. Their friends further offered it to the Government at 22s. per cwt. c.i.f. London, for white Argentine sugar. This also was refused. The reasons, of course, were never given, as a Government Department cannot be expected to give itself away.

There were several cases where the regular traders were treated similarly.

In the meantime the freights from the Argentine for grain had gone up to 60s., and as the steamers were chartered specifically for cargoes of sugar the owners refused to allow them to be used for anything else at the same rate. The result of the attitude of the Government was that the "Imperial," which had on board nearly 3000 tons of sugar, had to have it discharged again, and the shippers had to resell it for another market. This involved them in very heavy losses.

The fact is that the whole of the action of the Government in the matter of sugar (as of other things) has been political. The contention of the merchants (who are neither gamblers nor speculators) is that, had they been allowed to carry on their business in the usual way, the demand and the increase in price which occurred (owing to the action of the Government and the small ring of speculators) would very soon have righted themselves, as the merchants would have brought sugar from all parts of the world. They would not, like the Government, have confined themselves to transport in British steamers. They would have chartered neutral steamers for the transport of sugar, and by this means many steamers which were employed in taking supplies to Germany—American, Norwegian, and Swedish steamers—would, in addition to the British steamers, have been chartered by the British merchants to bring sugar and other produce to this country. The merchants would not have bought the enormous quantity of produce all at one time, as the Government did, and thus send up prices.

As a proof that the action of the Government tended to inflate prices, you only have to look at the position of the Java sugar to-day, three years after the outbreak of the war. Whilst the Government in October, 1914, had sent the price of Java sugar up to over 20s. f.o.b., the same sugar can be bought to-day in Java at 14s. f.o.b. The great difficulty always has been one of transport. Here again the confusion and muddle have been appalling in the way boats have been utilized—not to the best advantage of the community—by centralizing everything. It stands to reason that one man cannot do the work of hundreds—at least, to do it efficiently.

Now, as regards the question of distribution. At first, one gentleman, who had the ear of the Sugar Department, endeavoured to get a monopoly of the distribution. There was a big outcry in the City amongst the dealers and brokers who, for years, had been doing this business, and who all had their own connexions. They resented (and very rightly resented) the attempt made to rob them of their livelihood. In answer to a deputation, it was decided, after considerable difficulty, that the brokers and dealers were to be allowed to continue to do their business, but the gentleman who had been instrumental in inaugurating the Government interference, was put in a position which enabled him to demand of everybody who came for supplies, the names of their buyers. This action has been, and is still, very much resented by the trade, as it was considered wholly unnecessary that an ordinary member of the trade should be put in a position to learn the business of all his competitors, and, consequently, inflict upon them a great injury in the future.

This Report[1] amounts to a pretty severe condemnation of Government control; and the memorandum above reproduced is a very striking exposé. No comment which we could write now would be so telling as the following short extract from our issue of January, 1916 (page 6). We support our statements with the actual figures of the prices, top and bottom. We can develop them further if they are disputed, in fact we did so in another article on the same subject.

"The British Government thought they would steal a march on the rest of the world's sugar consumers by laying in (in a hurry) such a stock of sugar as would at all events keep the British consumer supplied for many months to come. They were most successful. They secured a million tons at what they thought was a very moderate price, only a little more than double the usual figure. They were so pleased that they actually congratulated the House of Commons on their success in saving the consumers from the evil effects of undue speculation and consequent high prices. It did not occur to them that their little speculation in buying a million tons of sugar was the biggest gamble Mincing Lane had ever seen, and that the rise in price caused by it far exceeded any former rise in sugar during so brief a period. Neither did it occur to them that possibly, when they completed their monster operation prices might fall to the old level. But, alas, that is exactly what happened. The British Government had wasted not only their time but their money. Never mind; they promptly prohibited the importation of cheap sugar and made the consumers pay the cost of their unfortunate little purchase. . . . . . The sugar markets of the world, in October and November, 1914, fully realized the fact that the scare in August was without any solid foundation. . . . . . Prices began to fall, and by the end of October the price of sugar in the United States was 3 cents per lb.—i.e., 1½d. per lb., or £14 per ton below the top. On the 2nd November, 1914, Cuba centrifugals were sold at 2·44 cents per lb., cost and freight to New York, exactly the price quoted on the 15th June." Verb. sap.

---

[1] This Report, be it observed, is drawn up by a Committee of private members of the House of Commons and not by a Committee appointed by the Government. It therefore possesses a freedom of action and criticism such as is frequently absent from Government Committees.

Metal Hardness and its Relation to Wear.

By FRANK COXON.

For many purposes in the sugar factory hardness of materials is specified or desired in various degrees, but when actual conditions of working imply wear the engineer does not really require hardness, although he asks for it. What he does desire is resistance to wear or to deformation, or some other property or combination of properties which is of importance for the particular purpose in view.

Thus, if we consider grinding or wearing, it is necessary, if the metal is not to wear away quickly, (1) that the particles on the surface shall not be readily displaced, and (2) that the particles so displaced shall not readily be removed. Both conditions are necessary, either alone is not sufficient. Substances which are really hard do not permit of these particles being readily displaced, providing their microscopic structure is suitable—hence they will wear well. Plastic materials do not permit of these displaced particles being readily removed—hence they, too, may give good wearing surfaces though they are not really very soft.

The good wearing properties of manganese steel, for instance, would appear to be due to two causes: (*a*) the relative high natural hardness of the metal itself, and (*b*) the fact that the particles which are so displaced from the outer surface do not come away and form a powder, but are plastically spread over other parts of the surface; they are thus capable of being repeatedly displaced and are work-hardened before being ultimately lost.

The extent to which the metal will work-harden is a very strong factor, for the higher this property is manifest the tougher the metal and its suitability for wearing purposes.

There are two methods adopted by present day engineers for testing the physical hardness of materials; one is the Brinnell Ball and the other the Sclerescope. The former is a hardened steel ball which is pressed into the metal to be tested and the indentation noted. This test has some disadvantages, the chief being that the metal displaced by the indentation becomes more or less work-hardened and another test in the same place will not give the same result, also that the hardness of the steel ball limits the machine's capacity to a quality of metal considerably below this hardness.

The modern Sclerescope is considered to be more accurate and more readily adaptable to practical application, its indications being measured by the rebound of a diamond pointed hammer striking the material to be tested, the degrees of rebound deciding the hardness.

The utility however of both these instruments is of little value unless much comparative data is prepared; for instance, two mill brasses may be found to have a considerable difference in their hardness number, yet the harder metal may wear badly. Faulty mixtures, melting, or burning may easily account for this, yet whilst the brass would pass the condition (*1*) and (*a*), it would utterly fail in the properties of (*2*) and (*b*).

Again, the softer metal may wear badly and not follow the property of plastic metals, that of not permitting the displaced particles to be readily removed, due to the same faults in actual manufacture.

Cast-iron also requires careful consideration, since a hardness test would in some cases indicate good metal of a class equal to all the conditions outlined *1* and *2* and *a* and *b*, yet the latter of each set would be fatal in a mill roller and produce in this case a great degree of smoothness.

With material like steel the factory engineer can in most cases ignore special care and the many so-called kinds of hardness, it being sufficient to know that the bushes and pins say, of a roller chain are 85 hardness while the links are 60. It is this comparative information that for practical purposes has led to a wide use of the Sclerescope.

Given a favourable microscopic structure or proof that the best care has been used in manufacture, the following factors must be duly noted in making estimations of the physical hardness: (*1*) Lubricated and unlubricated friction; (*2*) hot and cold friction; (*3*) high speed and low speed friction; (*4*) the relation of hardness of one member against another; (*5*) the pressure; (*6*) the intervention of grit.

Friction under heat elicits rapid wear for several reasons, loss of hardness due to heated state, the decreasing effectiveness of lubrication, and tendency towards welding affinity of the molecules.

Under high speed, the pressures are increased due to vibrational shocks with a corresponding tendency to disintegration owing to surface burning.

The relation of hardness in one member against another is perhaps most important in ordinary machine construction where the more valuable member should always be the harder. For instance, the armature shaft of an electric motor should be harder than the bearings, which can be more easily replaceable. In fact, all replaceable parts should be selected as of such a hardness and other physical property as will wear more rapidly than the least replaceable parts.

The hardness due to cold working or work-hardness in steel shafts is thus not nearly so effective as a similar hardness due to heat treatment, etc. Metals that show satisfactory resistance to wear at a normal hardness may become useless when the pressure is great enough to crush their crystalline structure. This applies particularly to the brittle but soft babbitt metals, etc.

The intervention of grit is liable to cause results contrary to what is expected. Thus, if two discs were caused to rub against one another, one of hardened steel and the other of very soft metal, the softer metals would normally be worn down by the hard steel. If, now, there chanced to be grit harder than the steel placed between, it would embed itself in the soft metal and thus form a lap against the hard steel. The soft metal, now having a super-hard face, will turn the wear practically all against the hard steel. The grit, which in this instance has reversed the wear from one to the other, is particularly suggestive, and illustrates well the influence of super-hard particles in a metal which, like the grit, exerts a lap effect against other materials having perhaps a superior physical hardness but a want of a similar favourable microscopic structure.

These few notes, in no way complete, may suggest some solution to one or other of the many troubles in wear at present unfathomed, whilst at the same time they clearly show that when the testing of material hardness is carried out, the hardness figures are useless where wear is concerned unless the many factors of conditions of working and quality of material are taken into account.

Centrifugal Pumps in the Sugar Factory.

By JAMES HAMILL.

The increasing use which is made of centrifugal pumps for all manner of pumping services is one of the outstanding features of present day engineering. This type of pump is now being widely used for work which a few years ago was considered the exclusive field for the reciprocating type, such as for boiler feeding, hydraulic supply, deep mine pumping, waterworks supply, and for pumping chemicals and trade liquors of diverse natures. Doubtless this is due in a great measure to the more extended use of electric motor and steam turbine drives which operate at fairly high speeds, and to a general reluctance to use gearing or belts to reduce these speeds sufficiently to suit reciprocating pumps; but it is also due to the lower first cost of the centrifugal type together with its greater simplicity and more compact design, The centrifugal pump can be made to operate at a wide range of speeds and can generally be direct-coupled to such driving agents as motors and turbines, while of course for many years the standard circulating pump has been an engine-driven centrifugal unit.

Considerations governing speed.—Whilst centrifugal pumps can be designed for a wide range of speeds, there is for any set of conditions of head and volume a most efficient speed depending on the particular type under consideration. The factors governing this most efficient speed are primarily a question of design and as such are not possible of treatment within the limits of this article, and indeed would not be of general interest, but since sugar factory engineers will be more and more concerned with this type of "liquid mover" in the future, a few general hints may be of use to them in specifying their requirements to pump manufacturers, to the mutual satisfaction of both.

In a general way it is true to say that for large volumes and low lifts such as circulating and irrigation pumps the speed will be low, whilst for small capacities and high heads such as boiler feeding, juice heater service, etc., the speed will be high. This is governed by the fact that the most efficient diameter of the impeller bears a relation to the diameter of pump inlet and discharge branches, usually 1½ or 2 to 1, and that in turn the velocity of the impeller tip bears a relation to the head or lift, the velocity (feet per second) being in the neighbourhood of $\sqrt{H \times G}$, for ordinary blade angles where H = Head in feet, $G = 32{\cdot}2$.

It follows therefore that for a large volume the pump branches will be large, the impeller diameter will be large, and it will generate a moderate pressure or "head" at a comparatively slow speed, whilst should the capacity be small, the pump branches and impeller diameter will be in proportion, so that if the head required be great, the impeller will require to operate at a high speed to give the necessary velocity. It is this factor that makes the multi-stage pump necessary at ordinary speeds for small to moderate volumes at high heads, a number of impellers being used in "series" on the same shaft to produce higher heads than are obtainable with a single impeller.

Conversely if with large volumes at low heads the speed should be too slow for an economical type of motor, two or more smaller impellers are sometimes arranged on the one shaft working in "parallel," each impeller dealing with a half, third or a fourth of the total volume, and enabling a higher working speed of revolution to be obtained.

Types of drives.—The nature of the available electric supply will also affect the speed. With 50-cycle alternating current, the speeds will be limited to 2880, 1440, 720, 580, 475 revs. per min. or lower, whilst with direct current it will generally be found advisable not to exceed 2200 revs. for the smallest sizes and to adopt lesser speeds according to the power of the motor. Where turbine drives are required there is a much wider choice of speeds, but as it will generally be found that the best turbine speed is higher than the best pump speed, a compromise will have to be struck. For single stage boiler feed and pressure pumps, speeds of 3000 to 5000 revs. per min. are sometimes adopted, but in the ordinary way a moderate speed of 2000 to 3000 revs. per min. will be most desirable where the two pumps are coupled together and mounted on an ordinary baseplate, while turbines having a better steam economy than duplex pumps can frequently be arranged at speeds down to 1250 revs. per min., depending on the power and steam conditions. The wear and tear of the ordinary type of pump glands is a factor to be borne in mind at high speeds, and these parts require more careful packing than does the ordinary reciprocating pump spindle, especially where the liquid is unclean or gritty. Therefore, with moderate speeds greater life and less attention is likely to result. With ordinary attention and clean liquids, however, speeds even up to 5000 revs. per min. need cause no anxiety.

Nothing has been said so far about belt or rope drives, but where other methods are not possible and there is space available, these forms of drive can often be used to advantage for low to moderate powers, whilst suitable speeds can invariably be arranged to suit existing line shafting or pulleys. With belting the point to be borne in mind is that a thick belt will not lie satisfactorily on a small pulley, so that as pump pulleys are invariably small, a thin belt should be chosen of sufficient width to transmit the power. With ropes the same consideration rules, and the pulley should not be less than 30 times the rope diameter.

A further alternative type of drive which has come into prominence as a result of modern conditions is by high speed reduction gearing.

For some years gear drives have been under suspicion as a result of dissatisfaction due to heating and wearing troubles, but great advances have recently been made, and if properly proportioned for their duty, and made by a maker of known repute, there is much to recommend them. It frequently happens that a turbine drive is desired for a pump which operates at a slow speed, and numbers of such units from 100 to 500 H.P. are now in use in central power stations, the turbines running at about 3500 revs. and the pumps (usually circulating pumps) at 500 to 900 revs. per min. As a rule the gearing will be fitted with forced lubrication and a suitable cooler for the oil.

The Estimation of Head and Capacity.—With reciprocating pumps it is not usually necessary that the exact head and capacity of the pump be very accurately estimated, as the capacity can always be varied within limits, and extra head or lift can be dealt with by regulation of the steam stop valve, but the centrifugal pump is essentially a constant speed machine, unless provision is made for speed variation in the driving agent. With alternating current motor drive no such speed variation is possible, so that when specifying the duty the maximum rate of pumping should be specified and not the average. For instance, when specifying particulars for a mill juice pump, it is not sufficient to give a capacity based on the average 24 hours' crushing. The rate of flow of juice will continually vary, and an allowance over the "average" should be made to cover the maximum momentary flow, unless the juice tank be of a very large size indeed to act as a receiver. This allowance will vary, but should not be less than 25 per cent. Similar cases will suggest themselves, such as juice-heater pumps, filter-press pumps, etc.

Being a constant speed machine the centrifugal pump delivers a varying quantity as the head is increased or reduced, with the result that should the *head* be greater than allowed for in the design, the quantity delivered will be *less*, whilst if the head be less, a greater quantity will be pumped. This property is conveniently illustrated by what is termed the "characteristic curve" of the pump for head and volume, two forms of which are shown in the diagram (Fig. 1) at *A* and *B*. Starting at the left hand and upper end of the curve, the volume is zero, corresponding to the closed valve condition, whilst the pressure produced is a maximum. The curve then falls as the volume increases, until the working point is reached, under which condition the pump delivers its full volume at the specified head. After this point the curve falls more rapidly until zero head is reached, at which point the pump will deliver about 50 to 80 per cent. of its normal volume against its own internal fluid friction. The curve is shown for purposes of illustration only, but the curves of different types of pumps form an interesting study.

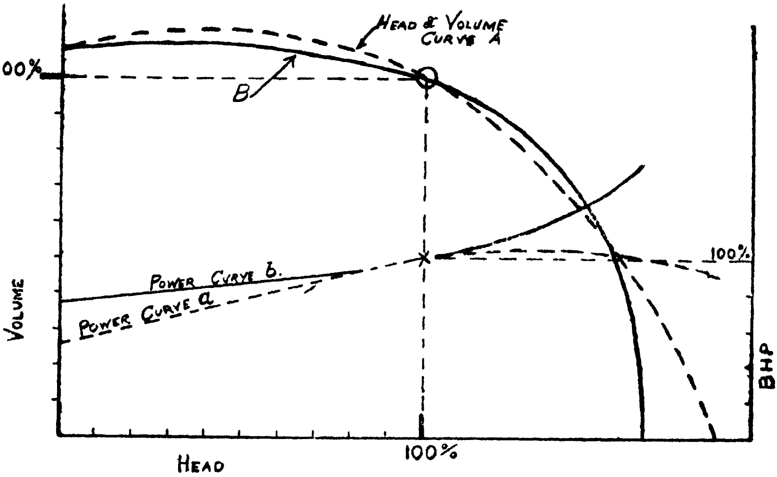


Fig. 1.

In general, however, it will be noticed that the heap must not be under-estimated if the full delivery and volume is expected, and ample allowance must be made for fluid friction, through piping, resistances of valves, bends, strainers, etc., and loss at entry to pipe.

With an existing pipe system, a test on the site with the existing pumps is easily carried out, and by this means reliable and extra data can be obtained for the new pump. Two gauges are required, one for the pump discharge branch, and one for the suction, as shown in Fig. 2. These two pressures added together plus the difference *H* (if any) in level between the gauges, give the "head" against which the pump is operating. The volume being delivered should be noted at the same time, for should the volume desired from the new pump be greater, an allowance will require to be made to cover increased pipe friction. Similarly the temperature should be noted, as the viscosity of a sugar solution is greater at low

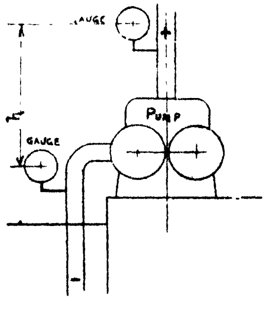


Fig. 2.

temperatures, and increased viscosity means increased total head and increased power to drive the pump. In any case, the maximum and minimum temperatures should be stated, and the pump designed for the lowest likely to be met with.

In addition to the advisability of not under-estimating the total head, it is also important with some makes of pumps that it should not be much in excess of actual head as, due to the lack of self-governing properties under some conditions, the power absorbed is likely to be very great at heads less than arranged for in the pump design. In Fig. 1 is shown the power curve, *a*, of a pump having self-regulating properties, and curve, *b*, of a pump without self-regulation. For heads greater than normal the curves do not differ materially, but for heads less than normal the non-regulating pump requires greatly increased power to drive, and if motor-driven may overload the motor. In any case it will not be efficient at lesser heads, whilst the self-regulating pump can be set to work at any point on the curve without concern, and may be safely ordered for heads in excess of the actual in cases where a margin is desired. Also, for duties where the head is liable to variation from time to time, such as pumping from a tidal river or delivering to a jet condenser, a self-governing pump is a necessity.

Installation.—A feature not usually fully realized with centrifugal pumps is he necessity of priming. The ordinary reciprocating juice pump can also act as an air pump for a short time at starting, so that it can exhaust the air from the suction side and draw its liquid to enable it to start. The centrifugal pump, however, acts through the medium of the liquid in the impeller, and until the impeller is filled no pumping can take place. Various means may be used to effect this, such as filling the pump through a funnel, by an air or steam ejector, or by placing the pump below the level of the supply—the latter is the most convenient plan. Should a quantity of air be mixed with the liquid, there is the danger of its separation into plugs, which are liable to break the even flow in the suction pipe and stop the working of the pump. In any case, air will reduce the capacity of the pump, and may also lead to excessive wear and noise. Care should therefore be taken to have the suction pipe joints thoroughly tight, the pump glands well sealed with water, or otherwise, and the end of the suction pipe immersed in the suction tank to such a depth that air is not drawn down by eddies, vortexes, or whirlpools. The depth should not be less than 2 ft. for a 2 in. pipe to 5 ft. for a 30 in. pipe. Greater submergence is an advantage.

The foregoing are general notes applicable to all pumping plants, but there are a number of special points in the application of these pumps to sugar factory work which may be of interest to sugar machinery engineers.

Mill Juice Pumps.—The raw juice as it flows from the strainer contains some fine grit and is also in an aerated condition which aids any corrosive action which the liquor may have on the material of the pump. The internal parts of the pump should be of gun metal and the spindle of manganese bronze, whilst the casing is usually of cast-iron, but with some juices a gun metal casing is desirable. The pump should be placed below the juice level to avoid the necessity of priming. When motor-driven, the only disadvantage is that the motor is not likely to be kept as clean as it should be, so that a vertical pump and motor might be an advantage, the pump being placed in the juice tank pit, and the motor above the mill floor level. For most cases a single stage pump will be suitable, and this is an advantage as no internal bearings will be necessary. In all cases the glands should be sealed with clean water to keep grit out of the packings if these are of the ordinary soft type. A very small quantity only should be necessary under a pressure of a few pounds per square inch.

Maceration Pumps.—As the liquid to be pumped is practically the same as in the mill juice pumps, the same consideration will apply. A useful fitting to eliminate close supervision is a by-pass from the delivery pipe to the tank controlled by a ball float, to prevent the pump running dry. A similar fitting might also be provided for the mill juice pump.

Juice Heater Pumps.—Owing to the high heads required for modern high speed heaters, it will usually be necessary to use a multi-stage pump and as the juice will mostly be gritty, water sealing should be used for the glands and decanted juice under pressure for the internal bushings. No pump with a balancing piston should be used as these are liable to wear. It is usually possible to lead a supply of clean juice from the evaporator tank or other source, and the quantity required will be small. Owing to the usually intermittent supply from the liming tanks it is advisable to have an ample margin in the pump capacity, and care should be taken that the pump is not "run dry," as of course the internal parts require the lubrication effect of the juice being pumped, although if sealed in the manner suggested above, it should run for some time without seizure. The usual materials are gun metal internal parts, bronze shaft, and cast-iron casing, although a bronze casing is always preferable.

Milk-of-Lime Pump.—A single stage pump will usually be found suitable operating at about 1440 revs., and the pipe connexions should be arranged so that there is always a reasonable flow of liquid through the pump. This is no disadvantage, as one of the main uses of these pumps is to keep up a circulation. Preferably the liquid should flow into the pump under a slight head to avoid the necessity of priming, as shown in Fig. 3, whilst clean water should be used for gland sealing. The pump materials should be steel and cast-iron, no brass being permissible. The lime tank should always be fitted with stirrers, and it will be found a convenience to have these driven by belt from the pump and motor coupling.

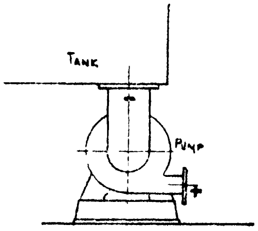


Fig. 3.

Evaporator Pumps. — Centrifugal type pumps have now been extensively used for extracting liquids from vessels under the highest vacuum and when properly installed they have proved more positive in action than reciprocating pumps, since temperatures do not have to be taken into account. The main proviso is that the liquid, either condensate or concentrated juice, should flow to the pump under a slight head, that the suction pipe should be of large bore and have a free run with easy bends. A non-return valve of a free-lifting type must be fitted to the discharge side, whilst a sluice valve on the discharge side is useful for regulation ; a similar valve on the suction side is a great convenience for overhauls. In regard to the gland sealing, which must be efficient, the condensate pumps may have the sealing supply led from the pressure side, and thus be "self-sealing"; but thick syrup is not very suitable for use in rotating glands unless a large quantity is used, so resort must be had to clean water sealing, which may slightly reduce the density of the concentrated syrup, especially at light loads. If, however, a slow speed pump is used, it may be possible to use some form of metallic oil lubricated gland, whilst clean juice from the evaporator supply tank might also be suitable at slow speed.

A single stage pump operating at 1440 revs. will usually be suitable for withdrawing from the vacuum space and delivering against 30 to 60 ft. external head, but for glands with metallic rubbing surface a slower speed of say 900 revs. per min. is to be preferred.

As to materials, a cast-iron pump fitted with gun metal parts and bronze shaft will usually be found quite suitable.

Remelted Sugar, Molasses, and Scum Pumps.—The main requirement when dealing with these liquids is to have them thoroughly well mixed or melted so that no settlement or separation of the solids can take place either in the supply tank or in the pump and pipes. The suction tanks should be fitted with efficient stirrers, so that the sugar is actually melted in the case of remelted seconds and molasses containing fine crystals. With scums the object is to keep the mud from separating out. In all these pumps a small supply of clean water should be available for gland sealing, and the liquid should flow under positive head to the pump through a straight pipe, with the suction branch on top, as shown in Fig. 3. For heads up to say 60 ft. a single stage pump will usually be sufficient, operating at about 720 to 1440 revs. per min.; but for pumps supplying filter-presses a multistage machine will be necessary to give 50 or 60 lbs. pressure, in which case the internal pump bushings should have a clean water supply under pressure for the lubrication. As may be imagined balancing pistons are inadmissible.

Injection Water and Cooling Tower Pumps.—Injection water pumps in a sugar factory are usually arranged to draw from the water supply pond or tank and deliver direct into a barometric condenser, being assisted by the vacuum in the latter. They must also be capable of delivering some water into the condenser without the assistance of vacuum, to facilitate starting up, and to keep the pans going in the event of a temporary breakdown of the vacuum pump. It is, therefore, necessary to specify the head and quantity required under both conditions, so that the pump may be designed for the most efficient duty. It is always of assistance to the designer to have a sketch showing the relative levels of water, pump, and condenser inlet. For this service a self-regulating pump is very desirable to enable it to operate efficiently at the varying heads without excessive power consumption. Regulation of the amount of cooling water is easily obtained by fitting a sluice valve on the pump discharge pipe or condenser inlet. It should never be fully closed, however, except for very short periods.

Cooling tower pumps usually operate at constant head, drawing from the hot well and delivering to the towers or sprays. If the latter, a stand pipe with an open top should be fitted close to the spray system, arranged that it will overflow and give warning if the spray nozzles become choked. As the water will be warm, a low suction lift should be provided; and as it is usually convenient to have the injection and tower pumps direct coupled and driven by one motor, they should each be fitted with a sluice discharge valve to permit of mutual regulation as to volume. The speeds of these pumps will vary considerably, but should not exceed 1440 revs. per min., whilst for large pumps slower speeds will be suitable, say 720 to 475 revs.

The materials will depend on the nature of the water, but usually a gunmetal impeller and steel shaft will be suitable. It should be borne in mind that at moderate to high speeds a high quality steel shaft is likely to have better wearing qualities than the ordinary bronzes, apart from the general question of corrosion.

Straining arrangements for these pumps should receive some attention, for whilst most centrifugal pumps will pass moderate-sized articles without injury, special shaped debris or leaves will most likely result in a "choke," with the attendant stoppage for clearing. Electric power stations drawing water from dirty canals or rivers in this country are now using various forms of automatic strainers, consisting of travelling bands, revolving cylinders, discs, etc., with great economy and advantage.

River Pumps.—In cases where the water supply is at some distance from the factory, special provision has to be made to convey the water to a suitable pond from which the condenser pumps are supplied. Culverts can sometimes be laid, but frequently pumps must be installed at the river, in which case electrically-driven pumps offer the best solution. In cases where the water level does not vary beyond the limits of the pump suction, say from 3 to 20 ft. total lift, horizontal pumps may be used, a suitable covered stage being erected over the river to carry the pumps and motors. Where the water level has a wider variation, however, vertical pumps offer advantages, a dry well being built of sufficient depth so that pumps are below the lowest water level, and vertical shafting provided to connect to vertical motors placed above the highest flood level. The weights of the revolving parts should be carried from bearings above the water level, whilst the intermediate shafting must be of ample rigidity and carried on substantial beams in the well.

Arranged thus, the pumps are self-priming, and need only occasional attention. The starting and stopping is easily effected electrically by means of automatic distant control gear placed in the factory under control of the engineer. The "contactor" type is now most commonly used for moderate powers, controlled from the factory switchboard by a small knife switch or push button.

Boiler Feed Pumps.—The application of centrifugal pumps to boiler feeding service is no longer in the experimental stages, and these are now in use in great numbers in all kinds of power plant and on board ship where absolute reliability and ease of operation are essential. A number have been successfully used in sugar factories, and greater use of this type will probably be made in the future.

They may be driven by A.C. or D.C. motors at speeds of 1400 to 2800 revs. per min., the requisite number of impellers being used to give the desired pressure. They may also be driven by direct coupled steam turbines at 2500 to 5000 revs. At the higher speeds a single impeller will produce the desired pressure, but it is questionable whether the best combination is not a two-stage pump operating at about 2500 to 3500 revs. per min., depending on the boiler pressure. Owing to the slower speeds, less wear and tear is likely to be experienced at the glands and bearings. The feed water in a sugar factory is mostly condensate, therefore clean, so that the glands may be self-sealing. Some makers make a point of casings split horizontally, but it is a matter of opinion whether this advantage is not obtained at the expense of greater internal leakage and complication.

Pressure Pumps for Centrifugals.—The driving of centrifugal machines by centrifugal pressure pumps offers no more difficulties than boiler feeding, but so far, the writer is not aware of any extended application to this service by British firms, although several are working successfully. American sugar houses however have installed them in numbers, displacing the duplex type with advantages in steam consumption and general operating expenses. The chief requirement of this service is that the pressure should be nearly constant in order that the speed of the centrifugals should be as uniform as possible to produce a standard product. The duplex pump fulfils this requirement, but the steam consumption is a serious item when the exhaust cannot be utilized in the pans. The characteristic curves of centrifugal pumps in Fig. 1 show that the pressure produced varies according to the volume or demand. The shape of the curve can be varied by designs, however, and can be kept very flat above the duty point, so that the pressure will never rise more than 5 to 8 per cent. above the normal, on the assumption that the speed remains constant. If the speed is slightly varied, however, say by an automatic pressure regulator on a turbine driven pump or by shunt regulation in a D.C. motor-driven pump, the pressure can be kept constant within a few per cent. The advantages of the reciprocating pump are thus obtained together with the economy and simplicity of the rotary pump.

General.—There are many other types of rotary and centrifugal pumps adaptable for use on sugar factories, such as the Le Blanc rotary air pump, Rees-Roturbo rotary air pump and rotary condenser, but as these are somewhat special, particulars are best obtained from the makers. Similar types of plant might be mentioned, such as the Globe-Johnson air pump, but the writer is not aware that this has been applied to sugar factory work up to the present stage. It is hoped that the foregoing notes will be of use to engineers in the selection and installation of centrifugal types of pumping machinery, and that the various suggestions and recommendations put forward will help them to make the best use of this type of liquid mover.

The American Cane Sugar Industry.[1]

IV. Louisiana.

GENERAL.

History and progress of the industry.—Sugar canes were first planted in Louisiana in 1751. GAYARRE, in his history of Louisiana, says: "In this year (1751) two ships, which were transporting 200 regulars to Louisiana, stopped at Hispaniola. The Jesuits of that island obtained permission to put on board of those ships, and to send to the Jesuits of Louisiana, some sugar canes and some negroes who are used to the cultivation of this plant. The canes were put underground according to the directions given, on the plantation of the reverend fathers, which was immediately above Canal Street (New Orleans)."

The planted cane grew to maturity, but all efforts to make sugar from it were failures until 1791, when ANTONIO MENDEZ, after some years of experimenting, succeeded in making sugar with the aid of a sugar maker from Cuba or San Domingo named MORIN. In 1794, ETIENNE DE BORE demonstrated its possibilities by planting cane on a large scale, and "in 1795 he made a crop of sugar which sold for $12,000," says the historian. The sugar maker who watched the cooking of the cane juice up to the moment of granulation was ANTOINE MORIN, who was associated with MENDEZ in his previous experiments. The centennial of De Bore's successful commercial demonstration was celebrated by the Audubon Sugar School, in the graduation of its first class in June, 1894.

Until 1882 the growing of the cane and its manufacture into sugar were conducted in a more or less primitive manner. In that year the centralized plant came into existence, and more systematic methods were inaugurated in field and factory. In 1880 there were 1,144 small sugar factories in Louisiana, which worked up a crop yielding 121,886 tons of sugar.

In 1911, 187 factories worked up a crop of 5,930,008 tons of cane yielding 308,439 long tons of sugar, a yield much below normal on account of a disastrous frost. In 1880 there were 273 factories using horse power, five in 1900 and none in 1905. The factory development was marked further by the elimination of the open kettle and open strike pan process, and by the increasing use of the vacuum strike pan. In 1880 about 42 per cent. of the sugar produced in Louisiana was worked up in factories having the vacuum pan process. The census of manufacturers of 1909 for cane sugar reports a total of 316,829 tons of vacuum pan sugar produced and but 3678 tons of brown or open-kettle sugar.

---

[1] Abstracted from "The Cane Sugar Industry", an inquiry into the agricultural, manufacturing, and marketing costs in Hawaii, Porto Rico, Louisiana, and Cuba, by the United States Bureau of Foreign and Domestic Commerce. Miscellaneous Series, No. 53, Department of Commerce, Washington. (See *I.S.J.*, 1917, 359; also 1917, 420, 464, and 515).

Improvement in agricultural practices.—Scientific methods have also been applied to the growth of the cane. In 1885 the average yield per acre in Louisiana was about 1500 lbs.; in 1909 the average yield of cane per acre was about 20 tons, and the average yield of sugar per ton was over 157 lbs., or 3140 lbs. per acre. In 1885 a sugar experiment station was established by sugar planters and a scientist, Dr. W. T. STUBBS, placed in charge. It is now under the direction of the Louisiana State University.

This State experiment station at Audubon Park is a completely equipped plantation, sugar factory, and laboratory, operated by scientists who analyse the soil and the cane from every country, and issue bulletins from time to time, giving to the cane planter the results of their research, which relate to every phase of the growth and cultivation of cane. Bulletin No. 127, issued in May, 1911, by H. S. AGEE, B.Sc., chemist and sugar maker at Audubon Park, states that "the work of propagating new varieties of cane from seed has been in progress for several years at the station," and that this report is to show the nature of the work and to point out its encouraging features. The station reported upon standard canes, "the canes which had given the banner yields in Cuba, in Hawaii, and in other countries. The tonnage yields per acre and the analyses of the juice of all the varieties are recorded in the files of the work. . . . However, after completely reviewing the data and examining the varieties as they are to-day—some after many years' growth in their new environment—it cannot be said that any of them are worthy of replacing the varieties now most widely grown on the (Louisiana) plantations. Thus is emphasized the fact that Louisiana needs varieties of cane that are particularly suited to its short growing season."

Among the widely grown canes are those known as D74 and D95 from Demerara. "After three years' trial on the plots of the experiment station, they showed such favorable comparison over the purple and striped canes of Louisiana that a distribution of cuttings to the planter was begun. The wide popularity which these varieties have gained is well known. It is generally recognized that they possess a marked superiority in tonnage and sugar content and in other minor characteristics over the older Louisiana canes in nearly every part of the Louisiana sugar belt. Though ingenuity will in time give further improvement in agricultural practices, more economical devices for handling cane, and betterments in manufacturing processes, there is nothing of greater economic importance than finding for the Louisiana fields such varieties of cane as will contribute greatly to the returns of sugar per acre."

The average results from the canes named were as follows:—

	Per cent. Sucrose
D74	14·5
D95	14·4
Striped	12·35
Purple	10·20

D74 stands erect and is easier to handle, making machine cutting a possibility.

"As is well known, the sugar cane in Louisiana on account of the cool winters seldom reaches maturity. It is only during an exceptionally mild winter that the cane arrows and produces seed, and this occurrence then is confined entirely to the extreme southern parishes of the State along the Gulf. The conditions of growth and the methods of cultivating the cane crop in Louisiana are therefore necessarily very different from tropical countries. And as a result, very marked differences are evident in the composition of the cane and its products between the two regions. It should also be remarked that within Louisiana itself a great dissimilarity of conditions prevails, not only as regards climate, but also in the character of soils and process of manufacture, so that there are perhaps wider local variations in composition than are noticeable in any other cane-producing country."[1]

The soils of Louisiana.—Nearly all the land devoted to sugar cane is of alluvial origin, having been brought down the Mississippi from over a score of States. The soils vary from silty loams to very stiff clays. Those containing the largest fertility and having a large water holding capacity are the best adapted for large crops of cane. There are also red and brown lands varying from sandy loams to loamy clays in the area containing the Red River, and prairie lands of alluvial origin in the south-west. On the eastern bank of the Mississippi are bluff lands extending for some 200 miles from Vicksburg to Baton Rouge which provide sugar cane areas. These bluff and prairie lands, and the alluvial deposits of the rivers, give the soils upon which the sugar cane is cultivated in Louisiana. In many localities drainage ditches are required to secure proper drainage of the soil, and on some large plantations navigation canals are dug to facilitate and cheapen transport of the cane to the mills. This is especially essential in the alluvial districts, where only in very dry seasons can badly drained lands be made to yield large crops; in ordinary seasons such lands yield average results far below their natural capacity, for on them neither fertilizer nor cultivation have their full effects. Excellent results are obtained with open ditches which in the lower sugar districts should be as close as 100 to 125 feet and deep enough to hold to bottom water at least 3 feet below the surface.

Fertilizers.—Notwithstanding the richness and fertility of the soil, the canes exhaust its productive powers pretty soon, so once in three years a restorative crop is interjected. The land is rotated with (1) plant cane, (2) ratoons, and (3) corn and peas, the corn being sown before the cowpeas and used for feed. The cowpea vines are usually ploughed under but sometimes are made into hay for stock. Nothing can supplant the utility of the cowpeas in this short rotation. By their deep roots and immense foliage, they pump up from great depths and evaporate large quantities of water and thus place the soil in a condition relative to moisture most favourable to nitrification. At the same time they intensely shade the ground, thus protecting the nitrogen ferments from the destructive influences of direct sunlight. But their chief virtue lies in their extraordinary power of utilizing the free nitrogen of the air; they are therefore used once in three years to restore the nitrogen exhausted by two crops of cane. A crop of cowpeas, according to STUBBS, yields 100 lbs. of nitrogen per acre.

Besides this green manuring, resort is had to large quantities of artificial fertilizers, as much as $8 to $10 per acre being expended for this purpose.

PRODUCTION OF SUGAR CANE.

Area of population.——In the 23 producing parishes of Louisiana there were 40,000 farms in 1910, covering some 1,991,473 acres of improved lands, of which 313,475 acres were devoted to cane. On this acreage 4,793,263 tons of cane were raised in 1909-10. The total amount of cane produced by the State of Louisiana came to 4,941,996 tons.

---

[1] Bull. 91, La. Exp. Sta.

Planting.—The method of cultivation adopted in Louisiana is described by GARNAULT AGASSIZ as follows:—

"Ground that is to be planted in sugar cane is ploughed twice, once in the fall and once just before planting time, which for two-thirds of the crop is in the latter part of February or the beginning of March. The fall planting season extends from the middle of October to the middle of November. After ploughing, the land is tilled up in 6-ft. rows, which are opened up and the cane stalks placed in them by hand; those seed stalks side by side insure a stand, as very frequently cane is defective and will not germinate. The cane is then covered with 3 to 5 inches of soil, this operation being performed by a light plough. A heavy roller is then passed over the field and the cane is left to grow. After the cane sprouts, or shortly before, the season of active cultivation commences. A plough is passed on either side of each row and all surplus soil removed from the cane by a hoe, an operation which, requiring manual labour, is very tedious and expensive. As the cane grows, the dirt is continually stirred around it with standard riding cultivators; is continually fertilized with tankage, cotton seed, and various commercial fertilizers, and every weed is religiously kept down. From then on, until the cane has attained a height and density to make it impracticable, the growing cane is regularly cultivated with ploughs and disks, the soil being completely hilled up around it. The last period of cultivation commences, as a rule, about July 1st, at which time the middle of the rows is ploughed to a depth of 15 inches and the drainage perfected by the cutting of quarter drains, which run at right angles to the rows and empty into regular drainage ditches. The cane is then left until harvest time."

After plant cane and ratoons have been grown, the land is sown with cowpeas, which are ploughed in August or September, and fresh cane is planted in October. Ploughing in the green crop results according to STUBBS in an average increase of 7·42 tons per acre. While ploughs and disc cultivators are used extensively, the work of cultivating the canes is carried on laboriously by hand labour for the most part. Large numbers of negro men, women, and boys are employed with hoes in cutting away grass and weeding round the growing cane.

Harvesting.—Harvesting begins about the first of November, though some planters commence cutting early in October for the purpose of avoiding possible loss later during the grinding season from frosts. But experts say that the yield per ton in October is so small on account of the cane not being sufficiently matured that any loss by a disastrous frost, such as occurs not oftener than once in a decade, is much less than the annual loss caused by a too early harvest.

The cane is cut by hand labour, each stalk receiving the same attention. The cutter seizes the cane near the top with his left hand, strips it of its foliage with his knife, tops it, and then severs the stalk at the ground. After the cane is cut, it is loaded on large plantations by mechanical loaders, operated by gasoline engines into waggons of from 1½ to 2 tons capacity each. These are driven to hoisting derricks placed at convenient distances throughout the plantations, whereby the cane is loaded on to cars. The rail system employed may be either tramway, narrow gauge with plantation locomotives, or even standard gauge railroad where the cane is hauled from 20 to 120 miles to the factory. At the latter, a mechanical grab unloads the cane on to a carrier which conveys it to the Krajewski crushers. On the smaller plantations the cane is loaded by hand into waggons. A good cutter will average about 3 tons of cane per day.

The large plantations through a system of daily reports and apportionment of time and cost of each operation performed in the fields are enabled to keep excellent records and cost-accounting systems, exceptional in general agricultural operations. The principal factories keep detailed records of their operations from day to day during the grinding season, and their accounting systems will compare favourably with those of manufacturing industries in general.

Tenancies and Contracts.—Cane growers pay for their tenancies of land in various ways. Sometimes a fixed rent is paid, of which $5 is an average figure. Other tenants there are who instead of a fixed rent pay the landlord anything from one-quarter to one-third of the gross proceeds of the tonnage of cane produced and sold.

The price paid to growers for cane is based on a sliding scale, or rather upon the average price of prime yellow clarified sugar on the Louisiana sugar exchange for the week of delivery. If the agreed upon price is, say, 90 cents per ton, and if the price of prime yellow is quoted in a given week at 4 cents per lb., then the grower receives four times 90 cents, or $3·60 per ton for his cane. The rates for the cane vary between 80 cents and $1 per ton.

MANUFACTURE OF RAW SUGAR.

In 1909 there were in "Louisiana" 214 establishments manufacturing sugar, of which 204 were actually within that State, and 10 in adjacent States. In 1914 the figures had increased to 181, of which 168 were within the State. These 168 factories in 1914 ground 3,747,959 tons of cane, and produced therefrom 264,754 tons of sugar. Data collected from 52 different establishments give the following averages:—Tons of cane per acre, 18·29; tons of sugar per acre, 1·31; tons of cane to produce 1 ton of sugar, 13·96; lbs. of sugar per ton of cane, 143·26; cost of cane at mill per ton of cane, $4·27; cost of cane at mill per ton of sugar, $60·18; manufacturing costs per ton of sugar, $19·32; total cost, f.o.b. factory, per ton of sugar, $79·50.

Out of 172 factories reported on, 1 factory had a 12-roller mill, 13 had 9-roller mills, 1 had a 7-roller mill, 137 had 6-roller mills, 5 had 5-roller mills, and 15 had 3-roller mills.

⁂ This completes the list of countries dealt with by the Report of the Inquiry into the agricultural, manufacturing, and marketing costs of the various cane sugar industries within United States territory, of which we have been giving in recent numbers a brief abstract. Only casual reference has been made by us so far to the item of costs, as we considered it was best to give this subject in comparative form covering all the four countries involved. We therefore hope in an early number to complete the series by giving an abstract of the comparative figures of costs of production.

A considerable amount of attention has been given in recent years to the recovery of wax from the by-products of sugar cane, and the Imperial Institute state that such an industry has now been started on a small scale in Natal,[1] and samples of the first consignment shipped to this country have been found on examination to be of good quality. Sugar cane wax, it is thought, can be used as a substitute for the better known Carnuba wax in the manufacture of gramophone records, polishes, candles, etc.

---

[1] For details regarding the production and composition of Natal cane wax, see *I.S.J.* 1915, 311; and 1916, 22.

Cane Varieties at the Tucumán Experiment Station.

Harvest, 1916.

By W. E. CROSS, Ph.D.[1]

In the *Revista* of November, 1916 (Vol. VI, No. 6), an account was given by Mr. A. H. ROSENFELD of the work with foreign varieties of cane during five years. It is the purpose of this article to supplement it by the results of the 1916 harvest.

To discuss first the champion canes it may be said that these canes, when they were planted in 1914, formed the most promising varieties of the many kinds of cane under experimentation at the station. They include many of the Java varieties which were afterwards recommended unreservedly, and are now planted on a large scale in the province. They also include others which have not fulfilled their early promise. The J. 100 was an entire failure in the harvest of 1915, while in 1916 it had practically died out altogether. Almost as bad were the D. (?) and D. 95 which, having fallen to less than 300 kg. of sugar per hectare as first year stubble in 1915, gave practically no cane at all in the succeeding year.

Of the other canes, the Striped and Purple native varieties gave considerably less cane and sugar per acre than in the two previous years, due probably to the exceptionally bad climatic conditions of the year, including an insufficient rainfall and rather severe frosts. These climatic conditions should, of course, be taken into account in studying all the canes in relation to this year's harvest, especially as they were perhaps worse and more exceptional for Tucumán than the notoriously bad conditions of the year 1914-15.

The Manteica de Santa Barbara gave results which confirmed our opinion, based on the previous years' harvests, that it is a cane of indifferent tonnage and late maturity. Of the other canes, the two forage varieties, Kavangire and Sin Nombre 54, have maintained their reputation for high tonnage and late maturing. The Kavangire was not affected by the frost, however, and all that was left standing went on maturing until September, when the last batch was cut.

The B. 208 gave a considerably decreased yield of cane, and this of very low purity. The record for three years, however, with nearly 50 tons and 3·3 tons of sugar per hectare, is sufficiently good to warrant further trials with this variety.

With the four champion Java canes 36, 213, 234, 139, the high tonnage and good purities have been well maintained. The most interesting point brought out in the results is the excellent conduct of the J. 139, which has an average of 70,291 tons of cane and 4140 tons of sugar per hectare for the three years, having done better in this respect than all the other canes except the Java 36. While on the basis of this one experiment no assertion of general superiority would be justified, we feel that the evidence is at least sufficient to merit for this cane more consideration than it is receiving in many parts from those who dismiss it with a statement that it is of no use, or that they planted it but it died out. It must not be forgotten that this cane possesses the property of not deteriorating, except very slowly, after cutting—a property which should be extremely valuable in plantations where rapid transport to the factory cannot be assured.

CANES IMPORTED FROM LOUISIANA.

These canes were planted for the second time in July, 1913, the previous experiments having brought out the high yielding qualities of the Zwinga (together with its habits of late maturing, and therefore its unsuitability for the mill, except when it can be cut in August or September) and the promising qualities of the B. 3277, S.N. 179, and S.N. 189. The other canes did not show yields sufficient to make them very promising, although it was resolved to include them in the new experiment to see if they would become acclimatized to our conditions.

---

[1] In *Revista*, 1917, 8. Here abridged.

The canes were thus planted in one lot in 1913, and the report of the first two years of their growth was included in Mr. Rosenfeld's report of November, 1915. Many of the canes showed again this year their unsuitability to Tucumán conditions, and this year many of them died out. On the other hand, many of the most promising canes maintained their promise of being really good. Taking the three years' results together, these include Bambú de Tabandi (as a forage cane or a cane for late milling), S.N. 211, S.N. 179, Collyn's Seedling, S.N. 175, S.N. 189, B. 3277, D. 188, D. 69, and L. 60. Of these, however, D. 69 gave only a very low yield as second year's stubble, and this confirmed the indication of the previous experiments that this cane was only suitable to cultivate as plant cane, and perhaps as first year's stubble. The other canes mentioned all (except L. 60 with 2986 kg.) gave upwards of 3 tons of sugar per hectare for each of the three years, a result which is reasonably good when it is borne in mind that two of the three years brought climatic conditions of a nature exceptionally unsuitable for cane. Moreover, they are very considerably superior to the Morada and Rayada native canes, with their 2030 and 1235 kg. respectively per hectare. The rest of the canes showed indifferent results. The S.N. 211, S.N. 179, Collyn's Seedling, S.N. 175, S.N. 189, B. 3277, etc., are now regarded as promising, and they have been planted accordingly at a greater extension for further study.

It was unfortunate that the year 1915-16 was so unfavourable, as it resulted in low purities for all the canes, even though they were not harvested until the 5th of August. The highest average for purity for the three years is easily held by the B. 3277, which we regard as a promising early maturing cane.

EXPERIMENTS WITH NEW CANES.

A number of new canes were planted in a special lot in August, 1914. To these was added, in November, 1915, a very promising cane, imported from Hawaii, D. 1135. The first-mentioned canes were harvested and analysed in July, 1915, and the results obtained were included in the report of Mr. ROSENFELD (*Revista*, 1915, November). The canes were again harvested as first year's stubble in August, 1916. The analysis of the D. 1135 (planted in November, and, therefore, by no means mature) was as follows: Brix, 13·4; sucrose, 7·3; glucose, 2·4; purity, 54·5. This is a stout vigorous cane, which has the property of stooling very well, and appears to resist frost and dryness in a considerable degree. A whole row has been planted for this year, along with the other promising canes.

The results of the two harvests of these new canes indicate that the Ambar de Egipto and J. 228 may be considered as promising, and they have been re-planted in greater extension. The Egyptian Purple and Striped on the other hand were not as good as the native canes, while the Hawaiian canes as stubble were complete failures.

The D. 74.—This cane, which was introduced here with so much expectation of its duplicating the success it had in Louisiana, but which has paled into insignificance in comparison with the better Java and forage varieties, has now no more than an academic interest in this discussion. It has proved indeed barely better as a sugar producer than the native canes.

The Ambar de Egipto.—The success of the Ambar de Egipto is especially pleasing, as with 69 tons cane and 4·8 tons sugar per hectare, for first year stubble, it enters into the class of the Java canes. A similar success in the harvest of this year will justify a tentative recommendation of the cane on the part of the Station, and a distribution on a small scale to planters for experimental purposes.

THE EFFECT OF THE FROSTS OF 1916 ON THE NEW CANES.

In order to study the effect of the frosts of 1916 on the new canes, a lot containing the Java and Kavangire varieties was left over to be harvested later—on September 20th. The canes showed no appearance of being injured by the frost, the leaves being still green. However, as it had been claimed in some parts that the lack of colour change in the leaves did not indicate lack of damage, but merely a high chlorophyl content, it was resolved to leave the question to chemical test. It will be admitted of course that cane damaged by frost does not increase in maturity, that, in fact, with the arrival of the warmer weather of late August and September (if not before) a deterioration of the frozen cane sets in, with serious loss in purity. The analyses of these canes made the day of the harvest (September 20th) compared with those of the same class of cane made late in July, show that no deterioration could be said to have occurred in any case, and that in some cases (Kavangire, J. 234, J. 213, and, perhaps, J. 36) the evidence was distinct that the canes had gone on increasing in maturity throughout the winter. The Kavangire, especially, with a sucrose content of 15·4 per cent. and a purity of 81·5 per cent., is very satisfactory, indicating the possibility of this cane being harvested late (with advantage to the factory) even in a winter of considerable severity.

The lowest temperatures registered in the Station during the winter were:—

	°C.		°C.
June 8	— 1·5	July 5	— 2·5
,, 9	— 1·0	,, 6	— 1·0
,, 16	— 2·0	,, 15	— 1·5
,, 20	— 1·5	,, 28	— 1·5
,, 25	— 1·5	,, 29	— 2·0
,, 26	— 3·5		
,, 27	— 1·7		

THE WORK OF THE STATION ON VARIETIES, 1916-17.

This article would not be complete without a word on this subject. We will treat first of the *recommended Java canes, J. 36, J. 213, J. 234, J. 139, J. 228*, and the forage varieties, *Zwinga, Kavangire.*

These canes, while our study of them has been sufficiently complete to justify our recommendation of them as in general greatly superior to the native canes for industrial purposes, still present problems, the study of which is of great importance economically—especially as there is now no doubt that they will almost entirely replace the native canes in the Province within two or three years. Therefore, the following aspects of these canes are being carefully studied by the Station:—

Methods of planting.—Distance, number of rows, depth of planting; planting tops; deterioration after cutting, from point of view of planting.

Cane Varieties at the Tucumán Experiment Station.

Methods of Cultivation.—Replacing of native by modern methods with machines; replacing of cultivation by destroying the weeds by spraying with arsenite of soda and other poisons; leaving trash in rows without burning.

Fertilizers.—Experiments with Java cane, with phosphoric acid, potash, and nitrogen fertilizers; experiments with lime; experiments regarding stimulation of the cane by the use of certain catalytic substances, borax, etc.; experiments in hastening the ripening of the cane (especially canes like Zwinga, Kavangire, etc.), fertilizing them with certain chemical substances.

Irrigation.—Experiments in irrigation with all the Java and forage varieties recommended, applying sufficient water to the cane to complete, with the rain, a certain amount per month.

Rotation.—Trials with rotation of the recommended canes with other crops.

As regards the other varieties of cane, we have a small number of promising varieties, like B. 3277, Ambar de Egipto, etc., which are being studied in fairly big extension, to see if they present qualities which make them as good or better than the Java canes.

The rest of the varieties of cane in the station have been planted in a new exhibition plot, where they will be carefully watched for any signs of improvement or adaptability to local conditions.

A good feature of this year's work is the introduction of a number of new varieties of cane from many different countries, including Louisiana, Cuba, Porto Rico, Barbados, Trinidad, Hawaii, Java, Mauritius, and Brazil. Most of these countries are producing new seedling canes every year in their experiment stations, and the properties of these canes receive careful study. We have asked to have sent any of these canes which possess qualities which would make them promising in Tucumán, including those of early maturing, resistance to drought and frost, as well of course as high yield per hectare. It is admitted that with the wonderful success already achieved with the Java canes, it will be difficult to exceed the high standard of yield per acre which these canes set—nevertheless it must be said also that a variety which with the same yield would *mature* earlier would be a great boon to the industry in the province.

A high yielding, early maturing variety would enable the harvest to be started two or three weeks or more earlier than at present, with the corresponding increased independence of frost which this would ensure.

The canes as they arrive are minutely inspected by the pathologist and entomologist of the station for the discovery of diseases and insect pests. If approved, the canes are planted in the quarantine plot of the station, at a considerable distance from any other cane, in order that they can be watched for the possible development of diseased conditions which of course would necessitate their destruction.

Among the canes received already from Louisiana is one, the L. 511, which has given surprising results in its native country with regard to its property of early maturing. Mr. TAGGART, sub-director in charge of the Louisiana Experiment Station, who has been good enough to send us the canes mentioned, informs me that in the month of October (which corresponds here to the month of April) the L. 511 had a sucrose content of 16·5 per cent. It is to be hoped that this cane, which at present is growing well in our quarantine lot, will give equal results here.

The new canes which have been received and planted are :—

Origin.		Cane	Origin.		Cane.
Louisiana	..	L. 511	Brazil	..	B. 208
,,	..	L. 218	,,	..	B. 6450
,,	..	L. 231	,,	..	B. 3405
,,	..	L. 253	,,	..	Bambu Blanco
Barbados	..	B.H. 10 (12)	,,	..	Cayanna

In conclusion, I must mention the efforts of the Station to produce new Tucumân varieties from seed. Arrangements have already been made for the importation of seed from Barbados, Brazil, Hawaii, and other countries in the tropics, and it is hoped that the Station will soon produce the first Tucumân seedling.

The Guatemalan Sugar Industry.[1]

Next to coffee, sugar is the most important crop of Guatemala. While the cane flourishes in almost every region from the level of the sea to an altitude of 5000 ft., the chief sugar districts are in the provinces of Escuintla, Mazatenango and Solola, all on the Pacific Coast. The principal variety grown in the Republic, known as "Jamaiquina," was introduced from Jamaica. It grows luxuriantly, frequently reaching a height of 8 ft. and a diameter of 2½ in.

Another favourite variety which is planted extensively in the coast districts is the "Cristalina." The cane is usually planted from August to October, but it can also be planted in the early spring with good results. The area devoted to the cultivation of sugar in 1916 was 76,352 acres. The average production is about 42 quintals (of 101·4 lb. each) per acre. As yet the production of sugar in the Republic is mainly in the hands of natives. There are some German and British-owned estates, but very few plantations controlled by American capital.

It appears from a report by the United States Consul at Guatemala City that there are 20 sugar mills in the Pacific Coast region, each having an average crushing capacity of 12,000 quintals (540 tons) per day, and several smaller mills. The machinery used in the sugar mills is modern, and prior to the war was imported mainly from the United Kingdom and Germany. The grades of sugar manufactured are 86° to 89° brown sugar, and from 96° to 99° white sugar. The quality of sugar produced is declared to be excellent, and there is a large local demand for the product. The sugar exported is principally the raw product known in Guatemala as "moscabado" (muscovado). During 1915 Guatemala exported 109,188 quintals of sugar, valued at £67,000. Of this amount 63,671 quintals were sent to the United States, 25,190 quintals to Honduras, and the remainder to Panama and other countries of Central America.

The Guatemalan sugar industry has experienced a steady growth and development, especially during the past few years, high prices having stimulated growers to augment their production by increasing their plantings and using improved methods and machinery. So far as is known, no systematic attempt has been made to improve the varieties of cane grown; but it is understood that the Agricultural Department of Guatemala has formulated plans for experimental work with this object in view.

The year 1916 was one of exceptional prosperity with the sugar planters, the production of sugar amounting to some 300,000 quintals, valued at £277,000, and the indications are that the industry will continue to develop and expand.

In Bohemia experiments have been made, during the war, upon the possible effect of applying mineral acids to render more of the natural constituents of the soil available to the plant. The growth of sugar beet on field plots sprinkled before seed-time with dilute sulphuric acid at the rate of 2-4 kg. per acre was observed. It was found that the weights of root and leaves were less, but that the quantity and quality of the sugar were slightly greater than on the untreated soil.

---

[1] From *Journ. Royal Soc. Arts.*

France.

The Campaign of 1916-17.

The *Journal des Fabricants de Sucre* in its annual survey of the campaign in France shows by numerous statistics how great has been the blow dealt to the French sugar industry by the invasion of its territory by the German armies.

According to official figures, the number of beet factories at work during the 1916-17 season was 65, as compared with 64 in the preceding year. The length of the campaign at the factories averaged 66·6 days of 24 hours, as compared with a maximum of 80·5 days in 1905-06 and a minimum of 45·1 days in 1911-12.

The area sown with beets during 1916 was 77,506 hectares according to the Ministry of Agriculture, but the investigations of the growers put it at 66,974 hectares only. In 1914 the area sown was according to the official figures 242,337 hectares, of which at least 144,000 hectares were overrun by the German invasion. The yield of the present campaign under review is provisionally placed at 1,580,000 metric tons of roots, which corresponds to 23·5 metric tons to the hectare (say 9·4 tons to the acre) as compared with 18·1 tons in 1915.

Subject to revision, the following are the figures of production for the last few years and certain earlier years beginning with 1883.

Year.	Factories in operation.	Production (refined) in tons.	Yield in sugar % of roots.
1883-84	483	406,007	5·55
1890-91	377	615,242	9·46
1900-01	334	1,040,294	11·93
1910-11	239	650·493	11·80
1913-14	206	717,400	12·08
1914-15	69	302,960	11·50
1915-16	64	136,899	11·80
1916-17	65	185,435	11·70

The sugar production during 1916-17 came to 181,970 tons of centrifugal sugar as compared with 133,267 tons in the preceding campaign. The yield in the roots based on the production of sugar has been for the past five years as follows:—

Campaign.	Yield to the hectare, metric tons.	Yield % of beets.	Refined sugar per hectare, metric tons.
1912-13	29 109	12·95	3·755
1913-14	28·800	12·87	3·706
1914-15	26·712	11·33	3·026
1915-16	18·134	11·62	2·107
1916-17	23·500	11·51	2·702

The big drop of the last three years has been due to lack of fertilizers and an insufficiency of cultivation due to war conditions.

As regards the consumption, the figures for 1916-17 are only available for the first four months, when the amount was 269,191 tons; these however compare with a total for the year 1915-16 of 563,479 tons. In 1912-13 the consumption was 703,126 tons, and in 1913-14 (for 11 months) 651,350 tons.

In 1915-16 the imports of sugar amounted to 532,721 tons and the exports to 134,975 tons. The corresponding figures of the last pre-war year (1912-13) were 131,628 tons and 210,367 tons respectively.

Colonial Report.

BRITISH GUIANA.

The year 1916 has been a prosperous one for sugar estate proprietors, as good prices were obtained. Although there was an increase of £41,465 in the value of sugar exported, the quantity was less than that exported in 1915 by 14,574 tons, the figures for 1916 and 1915 being 101,650 tons, valued at £2,100,417, and 116,224 tons valued at £2,058,952, respectively. The quantity of rum shipped fell below the record established in 1915 by 311,396 proof gallons. Prices advanced during the year, and the value exceeded that of 1915 by £169,765. The exports for 1916 were 4,384,834 proof gallons, valued at £626,490, as against 4,698,230 proof gallons, valued at £456,725 exported in 1915. Of this, 4,242,817 proof gallons went to the United Kingdom.

The sugar crop was somewhat below the average. The returns submitted by sugar estates show that in 1916 more than four-fifths of the total area—78,350 acres—under sugar cane was planted in varieties other than the Bourbon. Only 9450 acres are now occupied by Bourbon unmixed with other varieties. Of the area, estimated at 68,900 acres, cultivated in new varieties, 88 per cent. was under canes raised from seed in this colony, while about 11 per cent. was occupied by varieties imported from Barbados. Of the total area in cane cultivation 4 per cent. is occupied by new varieties raised at the Georgetown Botanic Gardens.

Correspondence.

THE EXTRACTION OF SUGAR FROM FINAL MOLASSES.

TO THE EDITOR, "THE INTERNATIONAL SUGAR JOURNAL."

Sir,—In the September number of the *International Sugar Journal*, Dr. H. C. PRINSEN GEERLIGS, under the heading of "The Extraction of Sugar from Final Molasses," makes certain statements which seem to require a brief answer in the interest of progress in the art of Raw Sugar Manufacture.

Answering the latter part of Dr. GEERLIGS' communication first, for his information it may be stated that the method of boiling and treating second massecuite, as laid down by him, is, with certain modifications, in use on several plantations in this country (Hawaii). Massecuites of 60% purity, and 98% Brix however are not produced, but the method as adopted here provides for boiling second massecuites to a purity of from 52%—54%, and to a density of from 93%—95% Brix. On being dried these massecuites yield a sugar polarizing from 88%—92%, which is remelted to a syrup, and taken back into process for conversion into sugars for export. Final molasses resulting from the drying of such massecuites has a purity (Clerget-Brix) of from 36%—39%.

The average results in Final Molasses for a number of factories in Java for the year 1916, as given in the Reports of the Java Experiment Station, are as follows:—

Final Molasses	Sucrose (Clerget)	33·38%
,,	Purity (Clerget-Brix)	36·6%–36·7%

The sugar chemists in Java, following the lead of the Hawaiian Sugar Planters' Association, have adopted for some years the "Clerget-Brix" method of stating, or rather determining, the sucrose contents and purities of syrups, molasses, etc., in rendering sugar-house reports.

Solidified Final Molasses produced in Java, despite of what Dr. GEERLIGS says to the contrary, does exhibit the phenomenon of crystallization, as is disclosed in a letter attached, from the Sugar Technologist of the Hawaiian Sugar Planters'

Association. This sample of solidified molasses which was received from Java, is now in the cabinets of the Experiment Station in Honolulu.

With these facts before him, and the results of trials of a new process given out at the annual meeting of the Hawaiian Sugar Planters' Association in 1916 in his hands, will Dr. GEERLIGS still maintain that his theory is the last word in the question of recovering sugars in waste molasses?

Yours very truly,

J. N. S. WILLIAMS.

Experiment Station of the Hawaiian Sugar Planters' Association.

Mr. J. N. S. Williams,

Dear Sir,

SOLIDIFIED MOLASSES.

With reference to the solidified molasses referred to in our conversation yesterday, we would say that in 1913 a party of sugar men from the Eastern United States, including Dr. G. L. SPENCER, passed through here on their return from Java and left a small sample of solid molasses, which they had obtained in that country. It was then hard and brittle, but on standing in a glass-stoppered bottle it has taken up moisture and become liquified, so that it has now the consistency of an ordinary stiff molasses. On examination with a microscope it is seen to contain a very large number of minute grains of sugar, which have crystallized out of it.

Yours very truly,

R. S. NORRIS,

Sugar Technologist.

October 26th, 1917.

CUBAN SUGARS.

TO THE EDITOR, "THE INTERNATIONAL SUGAR JOURNAL."

Sir,—I have noticed your recent discussion on the condition of Cuban sugars imported into the United Kingdom, and beg to send you the following data.

The Cuban raw sugar market supplies almost, if not quite, exclusively sugar destined for refineries and sold on the basis of 96° test. At this polarization the maximum of profits is obtained, hence the producer is not justified in using any methods which would give a sugar of higher polarization, and a very ordinary defecation is all that is needed; in fact the producer under the terms of the sale is justified in selling as much dirt with the sugar as he can get rid of. On the other hand, if he filtered his juice instead of making 96° test sugar he might produce 96·8° test sugar but he would not be paid a just bonus for the 0·8 in excess and he would be paid nothing whatever for the extra cost of manufacture, and for the improved appearance of the sugar. Until sugars are sold on a more rational basis, raw sugars will always be dirty in appearance.

Actually, Cuban sugars as far as I have seen them—and my experience is fairly complete—appear far more dirty than they are; the actual amount of insoluble matter (dirt) is in my experience no more than 0·1 per cent. and in extreme cases may reach 0·2. This dirt is chiefly cane fibre and insoluble ash, neither of which is deleterious to consumption but only to the appearance. It is "natural" dirt and is not dirt from handling, for from the cane to the bag everything is mechanical and the sugar is not touched by hand. I have read the reports in your journal on the Cuban sugars sent to England, and I thought that they were entirely illfounded and squeamish, and that people who refused to eat such sugar were undeserving of consideration. Actually too, at this juncture, I personally believe that it would be economical to repress refining and to eat raw sugar entirely, and so make use of the ash, glucose, and non-sugar in the raw product. In short, I think that the experts who say that Cuban 96° test sugar is totally unfit for human consumption are quite wrong.

Yours truly,

X.

Brevities.

At a recent meeting of representatives of the Institute of Bankers, the Association of Chambers of Commerce, and the Decimal Association, held in London, unanimous agreement was reached in respect of a plan for decimalizing the British coinage with the present pound sterling as the unit; and it was further resolved to press the need for this reform through the Chambers of Commerce in all parts of the United Kingdom.

As showing the dependence on Germany for certain chemicals which has existed in the past, the case may be cited of the potash used in the British West Indies for fertilizing, which before the war nearly all came from the Stassfurt mines, in Germany.[*] As a consequence, a shortage of this chemical manure developed in 1915 at the Barbados sugar experiment stations, and it was only when a supply was obtained later on in the year from the United States that the needs of the potash manuring experiments could be met.

The death is announced at the age of 81 of Mr. WALLACE POTTER WILLETT, senior partner in the well known brokerage firm of Willett & Gray of Wall Street, New York. He was described as the dean of the sugar trade of New York, being considered one of its most unquestioned authorities, and he shone as an expert witness in sugar matters. His firm's *Sugar Trade Journal*, which he founded and edited for many years, is generally accounted the leading statistical publication in the sugar world, and his death will prove a severe loss to American sugar circles.

The Mulgrave Central Mill Co., Ltd., of Queensland, in their 21st annual report for the year ending last January, reveal a surplus of only £247 after allowing for all outgoings. The amount of cane crushed was about 79,000 tons, yielding 8850 tons of sugar, but operations were hampered by a strike lasting five weeks. The quantity of cane to a ton of sugar was 8·92 tons, which was much above the average. The sugar content fell from 15·69 to 13·66, while the price of the sugar remained at £18 for 94 per cent. N.T. raw sugar. In the present season a crop of about 95,000 tons of cane is looked forward to.

The Egyptian Government has recently started levying an excise duty on the sugar manufactured and consumed within its country to the amount of £14 7s. per ton. Increased revenue is urgently needed in Egypt, but owing to certain existing treaties it is not an easy matter to tax the business profits in Egypt of foreign firms; hence as sugar is selling at a low rate as compared with the ruling prices in other countries it is no hardship to saddle it with a tax which is expected to bring in £E800,000 a year. Owing to international treaties again, it is not possible to levy a super-tax on the profits of the foreign-owned sucreries, much as that step would be desirable to take, hence the excise duty is the only feasible imposition.

As an instance of what can be achieved in the judicious utilization of by-products, the following British Army economy is worth placing on record. At the beginning of the war there was in the military establishments a considerable wastage of table refuse which was at best sold as swill for pigs. Since March, 1916, however, all camp refuse of this sort has been purchased by a special department, and from the waste fats thus collected glycerin is extracted. The present rate of annual output of refined glycerin from this source is no less than 1200 tons, which will provide enough explosives for approximately 15 million 18-pounder cartridges. The glycerin is obtained for the Government at a cost of £59 10s. per ton, which compares favourably with the price ruling in America for this product, viz., £350. On the other hand, it is reported[*] from the United States that the Government chemists have discovered a process for manufacturing glycerin from sugar at a cost of 25 cents per lb. or less (say £112 per ton). If this discovery leads to the employment of sugar for such purposes during the war, it will naturally tend to enhance the existing scarcity of sugar for domestic consumption.

Review of Current Technical Literature.[1]

COMMERCIAL USE OF SACCHAROSE-INVERTING BACTERIA FOR THE MANUFACTURE OF LACTIC ACID, ACETIC ACID, AND ACETONE. *G. Mezzadroli. Bollettino dell'Associazione delle Industrie dello Zucchero e dell'Alcool, 1917, No. 10, 9, 142-145.*

Since 1913 the writer has been engaged at the Stazione de Bieticoltura of Rovigo, Italy, upon a series of studies and experiments on the utilization of beet-juice for directly converting sucrose into lactic acid, as an accessory manufacture by the side of that of alcohol and sugar. A useful solution of the problem has been found in certain bacteria found in sour milk and beet juice which have the property of inverting the sucrose before subjecting it to lactic fermentation. The writer has given the provisory names to the bacteria of *Bacilli saccaro-invertenti* and these he subdivides into *Bacilli invertenti-lactici* (inverting lactic bacilli) and *Bacilli invertenti-acetici* (inverting acetic bacteria).

Beet juice containing about 10 per cent. of sugar was sterilized for 30 minutes at 120° C. then inoculated with a pure culture of the "inverting lactic" bacteria and kept at the optimum growth temperature of 36-38° C. At the beginning of the experiment the liquid was brown; after a few hours it became clear, then amber yellow. It was then strongly acid, and on being neutralized with sterile sodium carbonate the fermentation continued vigorously until a second, third, or even fourth neutralization was required. The whole of the sodium carbonate may be added at once, for its presence in excess does not in any way affect the fermentation or the final product, lactic acid. Also, on immediately determining the optical rotation of the must, or liquid for fermentation, the writer observed on the first day a decrease of several degrees in the dextro-rotation, which increases so much that on the fourth day the rotation was about + 1; then it became — 1, thus changing sign and becoming levo-rotatory, and finally becoming neutral when almost all the sugar has disappeared. The lactic fermentation of the glucose and of the levulose resulting from the inversion proceed contemporaneously with the action of the bacterial sucrase.

For each 100 parts of sucrose fermented there is a yield of 60 to 80 per cent. of lactic acid, 10 to 20 per cent. of acetic acid, 1 to 7 per cent. of alcohol, traces of acetone and higher alcohols. The "inverting-lactic bacteria" have constantly given the same results for the three years, 1913 to December 1916, when the last experiment was made. Some races lose their power of inverting sucrose if grown for some generations on solid agar media, or alkaline glucose. Others, on the contrary, retain their fermentative powers, provided they are grown again in the same media as those from which they had previously been selected. The same is true for many races of many wild alcoholic ferments that are brought to carry out some industrial process by Mendelian adaptation.

The "inverting acetic" bacteria are more active than the preceding ones. The yields of acetic acid are not yet higher than those obtained in practice in acetic fermentation; yet it appears quite probable that it may soon be possible to obtain acetic acid directly from sucrose without passing by the intermediate stage of alcohol. With the information obtained and the yields that can be got, the application of this new process depends on the state of the market prices of acetic acid and acetone.

The author has obtained from 100 parts of sucrose 40 to 50 per cent. of acetic acid, 10 to 20 per cent. of lactic acid, 10 to 20 per cent. of ethyl alcohol, and

---

[1] This Review is copyright, and no part of it may be reproduced without permission.—(Editor, *I.S.J.*)

1 to 2 per cent. of acetone. The acetic fermentation proceeds more rapidly than the lactic fermentation, with abundant evolution of carbon dioxide, hydrogen, and small amounts of methane. The aerobic, macerating bacteria of the *asterosporus* type act similarly. One obtained from Prof. CARBONE, of the Bologna School of Hygiene, was found to give fair amounts of acetone, but not sufficient to warrant commercial application. In the course of a more thorough study of these bacteria, it is possible that a type could be found giving larger yields of acetone. Lactic acid can be changed by oxidation with hydrogen peroxide to *acetic acid*, and from the latter acetone can be obtained in commercial quantities more easily and at less cost.

FUNGI AND BACTERIA AS MEANS OF COMBATING INSECTS INJURIOUS TO THE SUGAR CANE. *J. Groenewege. Archief, 51, 2023--2033.*

Three years ago the author's attention was drawn to the use of parasitic fungi as a means of combating insects injurious to the cane, particularly to the larvae of *Adoretus compressus* which were found covered by an abundant mycelium, and a culture of this fungus showed it to be identical with the *Metarrhizium anisopliae* described by Gough and Rore and by Speare.

An attempt was made to infect 25 larvae of *Adoretus* by mixing earth in which the larvae were present with a culture of the fungus upon rice and potato. About a month later two of the larvae were found dead, infected with the fungus. In another experiment, use was made of the larvae of *Oryctes rhinoceros*. After a month 19 of the 24 larvae subjected to this treatment had succumbed to the disease by *Metarrhizium*, and two more were attacked by the same fungus. The experiments were continued in 1915 with larvae of *Holotrichia helleri*, 40 of which were infected by mixing the earth (previously sterilized) in which they occurred, with cultures of *Metarrhizium*. Five weeks later, 11 larvae had succumbed. Further experiments resulted in finding after three weeks' stay in infected earth 7 dead larvae, and after twelve days 12 dead larvae, all killed by *Metarrhizium*.

It is considered that these experiments have sufficiently demonstrated the inefficacy of this method for combating injurious insects. The majority of the larvae were only attacked when they were about to pupate. They had already been able, therefore, to do damage before they were infected. Another difficulty is that, even when the larvae had reached this stage, they only succumb in part to the disease caused by *Metarrhizium*. Further, thorough treatment with this fungus would entail considerable expense.

Reference is made to experiments with *Aspergillus parasiticus* on *Lecanium sacchari* (= *Pseudococcus calcelariae*). When cultures of this fungus was dusted upon the insects the results obtained were nil. A better result was obtained by whitewashing the insects with the cultures. The results in general were so unsatisfactory and the method so costly that the author did not resume his experiments, in view, moreover, of the fact that the damage done by these insects to the canes is not considerable. On studying the larvae of *Adoretus* which succumbed to the disease caused by *Metarrhizium*, several larvae attacked by another disease of bacterial origin were found. A bacillus was isolated 10-15 μ in length and 1·5-2 μ broad, to which was given the name *Bacterium gigas* n. sp. This bacterium forms reddish brown pigmented colonies upon agar-agar, is aerobic and resists mannite, levulose, galactose, maltose, sucrose, raffinose and dextrin in the presence of 0·05 per cent. K_2HPO_4 and 0·1 per cent. NH_4Cl. On another occasion, from a larva of *Adoretus*, another bacterium, *B. prodigiosum* was isolated. Experiments have been made on infecting the larvae of *Adoretus* with these two bacteria by mixing a pure culture with the earth in which the larvae were buried. The percentage of dead larvae was so small that the writer concluded they were only infected under special conditions. From the results obtained there seems little likelihood of finding a method of fighting insect pests by means of bacterial parasites.

Blast Furnace Flue Dust: A new Source of Potash. *Harold T. Cranfield.*

Journal of the Board of Agriculture, 1917, 24, No. 5, 526-530.

For several years past it has been known to chemists that the flue dust driven off from iron blast furnaces contains an appreciable percentage of potash, and from recent experiments the author is convinced that this may be an important source of potash, which if properly investigated and controlled may satisfy in the future at least half, and possibly three-quarters, of our agricultural needs.

These potash-bearing dusts vary enormously in colour and composition, in fact it is difficult to find two samples alike. The potash exists mainly as sulphate with a smaller proportion of chloride, the remainder being in an insoluble form, the availability of which is a subject for future investigation. The amount of soluble potash varies very much. In samples examined the difference lay between 50 and 70 per cent. of the total potash. After extracting the dust with hot water, and evaporating the solution, a white residue containing on the average 70 to 80 per cent. of potassium sulphate and chloride is obtained, the principal impurities of which are sodium chloride and calcium sulphate.

As to the actual amount of potash present in the flue dusts, as previously stated this varies greatly. The limits found from a number of analyses were for the total acid-soluble potash, 2·97 to 15·89, and for the water-soluble 1·23 to 9·25 per cent.

An approximate indication may be given of the total quantity of potash available from this source. The quantity of flue dust from each furnace per week averages 0·95 tons, or 50 tons per annum, that is for the 300 blast furnaces operating in Great Britain a total annual production of 15,000 tons, at least 50 per cent. of which represents soluble potash. A careful and thorough investigation of the question appears desirable.

Comparative Results with Calcium Cyanamide and Sulphate of Ammonia in the Manuring of Cane in Java. *J. M. Geerts.*

Mededeelingen van het Proefstation voor de Java Suiker-industrie, 24, No. 44.

In this article the author gives the results of a series of 78 trials carried out from 1905 to 1914 in order to compare the action of calcium cyanamide and sulphate of ammonia on sugar cane in Java. In 59 cases, sulphate of ammonia gave better results both as regards yield of cane and yield of sugar. The surplus given by sulphate of ammonia over calcium cyanamide is calculated at 2·5 per cent. for the yield of cane and 2 per cent. for that of sugar. In general the results have shown that sulphate of ammonia gave better results than cyanamide both in light and heavy soils; but one has the impression that cyanamide gives better results in light than in heavy soils.

Results of 16 trials showed that partial application of cyanamide before planting is preferable to an exclusive application after planting. Further, 13 other trials have shown the advantages of an application at 3 or 4 separate times, of which the first should be before the planting. When it is given at least one week before planting, and the subsequent applications are not allowed to come in contact with the plants, the cyanamide is transformed before reaching the rootlets, and there is scarcely any danger of an injurious action. Partial substitution of sulphate of ammonia by cyanamide is more certain than complete substitution, but the cyanamide should always be applied before the sulphate of ammonia. Finally it was found that cyanamide has no influence on the maturation of the cane.

RECOVERY OF THE VARIOUS CONSTITUENTS OF BEET MOLASSES AND A STUDY OF ITS NITROGENOUS PIGMENTS. *H. Friedrich. Zeitsch. Zuckerind. Böhm., 1917, 41, 614-617*; through *Journal of the Chemical Society, Trans., 1917, i, 544.*

It is stated by the author that he has been engaged since 1914 upon a method for the recovery of the various ingredients in beet molasses and upon a study of its nitrogenous pigments. He has found that about 72 per cent. of the sucrose can be precipitated in a pure white condition by mixing the molasses with an equal quantity of cold glacial acetic acid. Most of this acid may be recovered in a concentration of 71 per cent. by distillation, when a dark brown, asphalt-like mass is left containing about 18 per cent. of ash (23·75 per cent. potash). This residue may be worked up for betaine by trituration with about six times its bulk of methyl alcohol. The insoluble portion (27 per cent.) is a nitrogenous pigment containing about 3·4 per cent. of nitrogen, and yielding yellow derivatives on nitration. He agrees with STANĚK as to the origin and nature of the nitrogenous pigments of beet molasses, namely, that they owe their formation to the condensation of amino-acids with the sugars, or more probably with caramel substances. MAILLARD also has shown that free amino-acids react with the common sugars to form nitrogenous pigments. It was found by STANĚK that when solutions of invert sugar or sucrose are heated in an autoclave at 105-130°C. with sodium glutamate or aspartate, or with asparagin, carbon dioxide is liberated, the solutions becoming acidic, and dark pigments being formed which are almost completely precipitated by lead acetate. The same pigments are obtained if precipitated chalk is added to overcome the acidity. Without the amino-acid, the colour of the solution is not so deep, and the pigment is completely soluble in alcohol. With the amino-acid, nitrogenous substances which do not dissolve in alcohol are produced as well. A fraction, which somewhat resembles fuscazinic acid in being a very dark brown powder, soluble only in alkalis, has been isolated. Asparagin and aspartic acid give rise to much more of this product than glutamic acid.

SEDIMENTATION OF THE COLLOIDAL CUPROUS OXIDE IN THE DETERMINATION OF REDUCING SUGARS BY THE VOLUMETRIC METHOD. *D. Sidersky. Ann. Chim. anal., 1917, 22, 170.*

It has been observed that the addition of 5 grms. of magnesium sulphate per 500 c.c. of copper sulphate solution ensures rapid sedimentation of the colloidal cuprous oxide in the volumetric method of determining reducing sugars, calcium salts having the contrary effect. This is of particular value in determining sugar in urine. On adding the urine drop by drop to Fehling's solution containing magnesium sulphate, the cuprous oxide suddenly cakes together, and the next drop makes the solution perfectly clear. This point corresponds with the disappearance of copper from the solution, and is therefore the true end-point.

RELATION BETWEEN THE COLORATION AND MATURATION OF THE SUGAR CANE IN JAVA. *A. M. P. A. Scheltema. Archief, 1917, 25, Part 7, 189-196.*

It is well known that the colour of the stems of the cane may differ very greatly in the same variety, and that in fact these differences are sometimes so great that it is often impossible to use this coloration as a botanical characteristic in describing a given variety.

Having this observation in mind, the author has attempted to establish a correlation between the stage of maturation and the coloration in the variety E K 2. Samples of green, yellow, and red stems gave the following average sugar contents respectively :—

	Brix number.	Sugar content, per cent.
Green stems	16·10	7·88
Yellow ,, ...	16·98	9·48
Red ,, ...	16·90	9·62

These results seem to prove that the colour of the cane may give some indication of its degree of ripeness. The green cane is not yet ripe; when it becomes yellow it is already ripe, and it turns red in those places to which the light has easy access. It is proposed to carry out similar researches on other varieties of cane.

J. P. O.

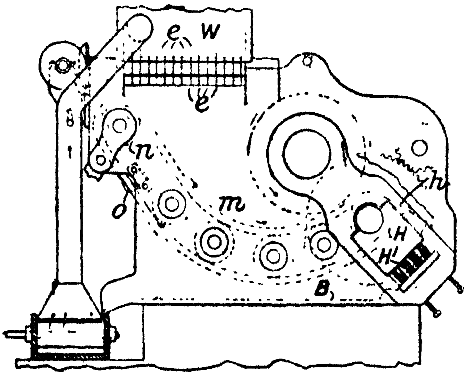
Review of Recent Patents.[1]

UNITED KINGDOM.

Chain-Belt for Cane Mill. *John W. Hyatt*, of 141, Commerce Street, Newark, N.J., U.S.A. *105,833* (*9558* of 1916). Applied for, July 6th, 1916. Accepted, May 3rd, 1917.

Means are described for improving the operation of a pervious chain-belt embracing several series of links combined in a single belt when used in a cane mill. The invention also provides special means of separating any loose fibres from the juice which has passed through the belt of chains. Heretofore, the pervious element has been formed of a composite chain consisting of chain-links placed side by side as well as end to end to form a single chain of suitable width, and the vegetable fibre has heretofore shown a tendency to wedge between the adjacent sides of the links of the belt, so as to spread its members apart and crowd them with great force against the cheeks of the supporting-frame.

In the present invention the accumulation of vegetable matter between the members of the chain is prevented by forming the belt of separate chains wholly independent of one another with sufficient interspaces for the escape of the juice, so that clearing-blades or any other suitable means may operate between the several chains and remove any fibre or deposit that penetrates the interstices, and thus prevent any accumulation of such matter which would obstruct the escape of juice, or crowd the chains unduly apart. To drive the chain-belt more positively than heretofore, the chain-links are made each with a tooth upon its inner side and form the supporting-roll or drum with grooves to receive such teeth, so that the teeth operate to feed all the separate chains at the same speed. In order to prevent the accumulation of fibres in the receptacles or passages for the extracted juice, such juice is discharged upon an endless apron made of pervious material like wire-cloth, so as to form a strainer through which the juice falls freely; while it conducts the fibres to an exhaust-tube by which they are sucked from the apron and discharged into the feeding-space or hopper of the machine, where such fibres mingle with the cane or crude material and are subjected again to pressure, which removes the juice therefrom.



In the figure is shown the side view of a mill in which a series of parallel chains *m*, preferably having internal teeth to ensure an even traverse, move between an upper roller *n* situated below the feed and around the driven roller *H* which is provided with recesses to receive the teeth on the chain. The roller *H* is adjustably mounted in block H^1 which also carries a scraper *h* bearing against the outer face of the chains. The interspaces between the chains may be cleared by a series of comb-like teeth *o* situated near the return end of the lower side or by deflecting the chains by a series of staggered rollers. The juice passes by a chute *B* to a sump having a perforated covering to collect any pieces of cane, these being drawn upward by a current of air and returned to the hopper *W*. The hopper feeds to the chain by means of two-toothed rollers *e* arranged one on each side.

---

[1] Copies of specifications of patents with their drawings can be obtained on application to the following:—*United Kingdom:* Comptroller of the Patent Office, Southampton Buildings, Chancery Lane, London, W.C. (price, 6d. each). *United States:* Commissioner of Patents, Washington, D C. (price 5 cents each). *France:* L'Imprimerie Nationale, 87, rue Vieille du Temple, Paris (price, 1 fr. 05 c. each). The date given in the heading of United Kingdom specifications is that of the application of the patent.

CENTRIFUGAL MACHINE FOR USE IN TREATMENT OF MATERIALS WITH ACID. *Thomas Broadbent & Sons, Ltd., and Horace Broadbent*, of Central Works, Huddersfield. *110,215* (*15,301* of 1916). Applied for October 27th, 1916. Accepted, October 18th, 1917. (Four figures.)

MANUFACTURE OF INULIN AND LEVULOSE *A. Daniel*, of 55, Mommsenstrasse, Charlottenburg, Germany. *109,813*. *Not yet accepted.*

In the production of inulin from vegetables the juices are purified from albuminoid matter, etc., by heating with alkaline reagents, such as sodium, potassium, or ammonium hydroxides or carbonates, hydroxides of calcium, barium, strontium, or magnesium, or lead acetate. The purified juice is concentrated to crystallize out the inulin, which is washed, and may be converted into levulose. The removal of albuminoid matter, etc., may be effected after the crystallization.

MANUFACTURE OF SACCHARIC AND TARTARIC ACIDS FROM SUGAR AND STARCH. *Diamalt Akt.-Ges.*, 5, Sonnenstrasse, Munich, Germany. *108,494*. *Not yet accepted.*

Saccharic and tartaric acids are obtained by the oxidation of carbohydrates in solution in the presence of metals or oxides or their salts acting as catalysts. Suitable carbohydrates are starch, glucose, maltose, or sucrose, suitable oxidizing agents are nitric acid, nitrogen oxides, ozone, oxygen, or air. As catalysts, heavy metals or their oxides or salts, e.g., molybdenum or mercury, or precious metals, e.g., platinum, may be used, either in solid, finely-divided, or colloidal form, or in solution; single or mixed catalysts may be used. The oxidation is preferably effected in sulphuric acid solution. Where nitric acid or nitogen oxides are employed, the evolved gases are collected and returned to the system. Oxalic acid is produced in small quantities as a by-product in the above process.

TREATMENT OF PEAT FOR FERTILIZERS. *A. Nightingale*, of Duck Mill Lane, Bedford. *108,543*. Applied for, August 18th, 1916

Peat for agricultural and horticultural purposes is treated with calcium oxide in order to neutralize the organic acids and to produce certain products which stimulate bacterial activity and plant development. The raw peat as dug or ground or in a dusty condition and containing from 50 to 70 per cent. by weight of moisture is thoroughly and rapidly mixed with one-fifth by weight of calcium oxide so that the temperature rises to 220° F.[1]

UNITED STATES.

CLOSED TANK FILTER PRESS. *David J. Kelly*, of Salt Lake City, Utah, U.S.A. (*a*) *1,158,055*, (*b*) *1,158,056* Patented, October 26th, 1915. (Eight figures.)

It is well known that in closed tank filters of the type shown in a prior patent[2] the general operation of the apparatus consists in building cakes to a thickness so that cakes on adjacent filtering frames or elements do not meet. This is done because it facilitates the impoverishment of the cakes by the application of a subsequent wash after the cakes have been built on the open filters; and it also provides for the discharge of the cakes. The cakes, built upon an open-leaf filter frame or element, contain a higher percentage of moisture than cakes built solid between adjacent filtering frames or elements.[3]

In the drawings is shown the filter tank *1*, closed on all sides, except one end. A slidable carrier *2* is designed to be moved in and out of the tank, and to facilitate this action wheels *2*¹ on tracks extending for a distance beyond the open end are provided. The carrier has rigidly fixed to it a head *3* for the closing of the open end when the carrier is moved into position, this being secured by any appropriate locking head mechanism.

---

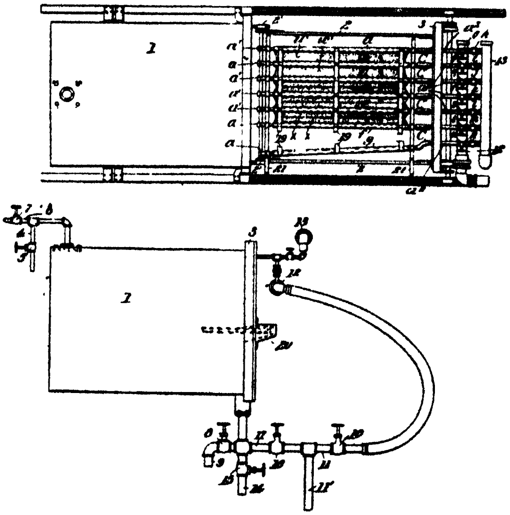
[1] Reference is made to specifications 3551 of 1878; 8931 of 1903; 16,162 of 1907; 14,487 of 1915; and 16,658 of 1915.

[2] U.S. Patent, 815,021.

[3] *Cf. I.S.J.*, 1917, 433–434.

The filter carrier is provided with any desired number of filter frames *a*, *b*, *c*, *d*, *e*, *f*, and *g*, arranged in parallel order, and suitably spaced apart from one another. These filter elements may consist of an interior foraminous plate *A* and fabric sides forming an enclosure.

In operating the apparatus, the muddy liquor is forced into the tank *1* under pressure through the pipe *14*, controlled by the valve *15*, and the air displaced by the filling of the tank is exhausted through the pipe *4*, controlled by the valve *5*. When the tank *1* is completely filled, the valve *5* controlling the air-exhaust pipe *4* is closed and pressure begins to act upon the filtering elements *a*, *b*, *c*, *d*, *e*, *f*, and *g*, causing a flow of the liquid through the fabric sides thereof and causing a deposit of solids to be arrested on the exterior surfaces of the frames. Filtration is continued until the flow of liquid from the filter elements practically ceases. The space between the filter frames is made of such a width as to insure obtaining a solid cake in an economical time limit. When the solid cakes are formed the excess unfiltered material is drained from the tank *1* by admitting compressed air through the pipe *6* controlled by the valve *7* and the valve *8* in the pipe *9* attached to the lower part of tank is opened. The next step is to fill the tank *1* with a suitable wash solution, which is allowed to enter the tank under pressure through the pipe *17* controlled by the valve *18*, the air displaced during this filling operation passing out through the pipe *4* as in the case of the filling of the tank with the slimes. When the tank is completely filled with the wash solution the valve *5* is closed. The wash solution, under pressure, completely surrounds the filtering elements with their attached cakes, but cannot enter them, as in the case where the cakes are not built solid, and in order to effect the desired wash of the cakes, and to remove therefrom any values which remain in the cakes, one opens the valve *10* in the pipe *11* leading to the manifold *12*, to which are connected the valve-controlled outlets a^2—a^6 from the individual filtering frames or elements. This permits the wash solution to enter the interior of the filter frames, or elements *b*, *d* and *f* through the valves *p*, *r* and *t*, which are left open, and causes a distribution of the wash solution throughout the entire interior of the filter frames, or elements *b*, *d* and *f*. The valves *h*, *j*, *l* and *n* of the alternate series of filter frames, or elements *a*, *c*, *e* and *g* are left open, and accordingly it is obvious that the solution under pressure in order to find an exit must pass through the solid cakes, following the direction of the arrows in the upper figure, thus displacing the values contained in the cakes, and remaining after the first expression of liquor or after the cake-building operation. The wash is continued to any desired point, after which the valve *18*, controlling the flow of wash solution to the tank should be closed, and also the valve *10* in the pipe *11* leading to the manifold *12*. The tank *1* is now drained in the same manner as with the slimes pulp.



The apparatus can now be opened for the discharge of the cakes, and this is done by unlocking the head *3* of the carrier and withdrawing the carrier from the tank, which may be done by gravity. One may employ any suitable mechanical means which will cause or permit the carrier to emerge, or be removed from the tank. When the carrier has been completely withdrawn from the tank, as shown in the upper figure, the cakes built solid between the filter frames, or elements, may be quickly dropped by pulling or forcing the frames or elements sidewise, as indicated, which operation increases the space between adjacent filter frames to a width greater than the thickness of the interposed cake, and thus permits the cake to drop from between the frames, or elements After the cakes have been discharged, the filter elements are returned to their original position, the carrier returns to the tank and is clamped into place, and the apparatus is again ready for another cycle of operations.

Apparatus for Drying Starch. *Joseph J. Merrill*, of Chicago, Ill., U.S.A. *1,183,097*. Patented, May 16th, 1916. (Four figures.)

Starch, as it comes from the settling tables, is an extremely difficult substance to handle. It contains approximately 50 per cent. of moisture and is heavy and sticky. As a result it is found to have a tendency to pack or clog in the bottom of the starch wagon so that besides failing to be dried properly the material in the lower portions of the compartments, under some conditions not always easily avoidable, instead of drying is, in a sense, cooked and discoloured. This, besides impairing the uniformity of the product and making a separation between the properly dried and defectively dried starch a necessity, interferes with the discharge of the starch from the bottom of the compartments when the bottom sheets or valves are withdrawn.

It has been found that these difficulties may be remedied and the method described in the Bauer patent,[1] improved by supporting the lower ends of the starch bodies on a foraminous support, for example, by making the bottoms of the wagons of a heavy wire mesh. This allows the extraction of moisture from the lower portions of the starch bodies to take place freely and prevents the discoloration of the starch and, to a large extent, the tendency to clog. This change in the construction of the wagon, however, necessitates a different method of discharging the dried starch therefrom as it is not feasible to construct wagons with removable leaves or valves of wire mesh. The inventor has, therefore, devised the expedient of inverting the wagons after they come from the starch tunnels and dumping their contents out from the top. The starch moves more freely in this direction, since any packing due to gravity has taken place by forces operating in the opposite direction. Moreover, if there should be any sticking of the starch in the extreme lower portions of the compartments this circumstance does not affect the free discharge of the bulk of the dried starch in the compartments.

Apparatus for the Manufacture of Modified Starches.[2] *Adolph W. H. Lenders*, of Cedar Rapids, Iowa, U.S.A. (*a*) *1,159,591*. Patented, November 9th, 1915. (Two figures.) (*b*) *1,191,324*. Patented, July 18th, 1916. (Eight figures.)

An apparatus is described for the manufacture of modified starches, as soluble starch, thin boiling starch, dextrin, British gum, and other conversion or partial conversion products. Means are provided for acidulating the starch, comprising a hollow element having a perforated wall; for mixing together the starch and acid in definite proportions; and for forcing the material through a perforated wall of the hollow element. By this means acidulation is so complete and uniform that it is possible to produce a product that is uniformly converted throughout, containing none of the black specks or other impurities characteristic of the ordinary commercially produced dextrins or like products.

UNITED KINGDOM APPLICATIONS.

Evaporating and Distilling Machinery. *D. Urquhart*. *14,217*. October 2nd, 1917.

Cane Mills. *J. Wilson*. *14,946*. October 16th, 1917.

Cooling Plates for Rectifying Apparatus. *Soc. E. Barbet et Fils et Cie.* *15,525*. October 25th, 1917. (France, October 31st, 1916.)

Filter. *D. B. Morison*. *16,444*. November 9th, 1917.

Multiple Effect Evaporator. *W. S. Herriot* (*N. Deerr*). *16,544*. November 12th, 1917.

---

[1] U.S. Patent, *1,035,302*.

[2] *Cf.* also U.S. Patents, Serial Nos. *766,332* and *847,280*.

Sugar Crops of the World.

(Willett & Gray's Estimates of Crops to November 1st, 1917.)

	Harvesting Period.	1917-18. Tons.	1916-17. Tons.	1915-16. Tons.
United States—Louisiana	Oct.-Jan.	225,000	271,339	122,768
Texas	,, ,,	2,000	6,250	1,000
Porto Rico	Jan.-June	475,000	448,567	431,335
Hawaiian Islands	Nov.-July	525,000	579,302	529,895
West Indies—St. Croix	Jan.-June	15,000	12,000	14,750
Cuba, *crop*	Dec.-June	3,200,000	3,023,720	3,007,915
British West Indies—Trinidad	Jan -June	70,000	70,891	64,231
Barbados, *exports*	,, ,,	65,000	55,000	65,000
Jamaica ,,	,, ,,	30,000	28,000	15,143
Other British West Indies	,, ,,	35,000	30,000	35,371
French West Indies—Martinique, *exports*	Jan.-July	40,000	40,000	39,925
Guadeloupe	,, ,,	40,000	40,000	34,111
San Domingo, *exports*	Jan.-June	145,000	130,171	126,058
Mexico, *crop*	Dec.-June	35,000	50,000	65,000
Central America	Jan.-June	25,000	25,000	35,000
South America—				
Demerara, *exports*	Oct.-Dec. and May-June	120,000	120,000	116,224
Surinam, *crop*	Oct. Jan.	15,000	15,000	13,000
Venezuela	Oct.-Dec.	15,000	15,000	7,000
Ecuador	Oct.-Feb.	8,000	8,000	7,567
Peru	Oct -Feb.	265,000	250,000	250,000
Argentina	June-Nov.	150,000	84,069	149,299
Brazil	Oct.-Feb.	375,000	300,000	194,000
Total in America		5,865,000	5,602,309	5,324,592
Asia—Brit. India, *crop* (consumed locally)	Dec.-May	2,750,000	2,626,000	2,634,000
Java	May-Nov.	1,800,000	1,596,174	1,198,567
Formosa and Japan, *crops*	Nov.-June	450,000	436,026	405,227
Philippine Islands, *exports*	,, ,,	250,000	170,000	332,158
Total in Asia		5,250,000	4,828,200	4,569,952
Australia	June-Nov.	265,000	195,000	159,681
Fiji Islands, *exports*	,, ,,	100,000	100,000	90,000
Total in Australia and Polynesia		365,000	295,000	249,681
Africa—Egypt, *crop* (consumed locally)	Jan.-June	100,000	101,832	98,964
Mauritius, *crop*	Aug.-Jan.	224,000	209,169	215,528
Réunion, *exports*	,, ,,	45,000	45,000	45,000
Natal, *crop*	May-Oct.	115,000	114,504	115,481
Mozambique, *crop*	,, ,,	50,000	55,000	50,000
Total in Africa		534,000	525,505	524,973
Europe—Spain	Dec.-June	6,000	6,000	6,359
Total cane sugar crops		12,020,000	11,257,014	10,675,557
Europe—				
Beet sugar crops	Sept.-Jan.	3,849,000	4,555,407	5,077,760
United States—				
Beet sugar crop	July-Jan.	875,000	734,577	779,756
Canada—				
Beet sugar crop	Oct.-Dec.	12,500	12,500	17,641
Grand total cane and beet sugar	**Tons**	**16,756,500**	**16,559,498**	**16,550,714**
Estimated increase in the world's production	,,	197,002	....	....

United States.

(Willett & Gray, &c.)

(Tons of 2,240 lbs.)	1917. Tons.	1916 Tons.
Total Receipts January 1st to November 15th	2,267,986	2,531,913
Receipts of Refined ,, ,,	—	—
Deliveries ,, ,,	2,278,951	2,525,173
Importers' Stocks, November 14th	—	10,818
Total Stocks, November 14th	6,296	62,172
Stocks in Cuba, November 14th	26,578	97,279
	1916.	1915.
Total Consumption for twelve months	3,658,607	3,801,531

Cuba.

STATEMENT OF EXPORTS AND STOCKS OF SUGAR, 1914-1915, 1915-1916, AND 1916-1917.

(Tons of 2,240 lbs.)	1914 15 Tons.	1915 16. Tons.	1916-17. Tons.
Exports	2,292,193	2,777,565	2,884.284
Stocks	183,113	140,958	31,971
	2,475,306	2,918,523	2,916.255
Local Consumption	71,340	72,970	84 400
Receipts at Ports to October 31st	2,546,646	2,991,493	3,000,655

Havana, October 31st, 1917. J. GUMA.– L MEJER.

United Kingdom.

EXPORTS OF SUGAR.

	MONTH ENDING OCTOBER 31ST 1916. Tons.	MONTH ENDING OCTOBER 31ST 1917 Tons.	TEN MONTHS ENDING OCTOBER 31ST. 1916. Tons.	TEN MONTHS ENDING OCTOBER 31ST. 1917. Tons.
BRITISH REFINED SUGARS :—				
Refined and Candy	164	131	4,233	981
Total	164	131	4,233	981
FOREIGN AND COLONIAL SUGARS :—				
Refined and Candy	42	1	919	24
Unrefined	34	21	3,183	590
Various Mixed in Bond	—	—	—	—
Molasses	79	9	885	30
Total Exports	**319**	**162**	**9,220**	**1,625**

I. A. R. I. 75.

IMPERIAL AGRICULTURAL RESEARCH
INSTITUTE LIBRARY
NEW DELHI.

Date of issue.	Date of issue.	Date of issue.